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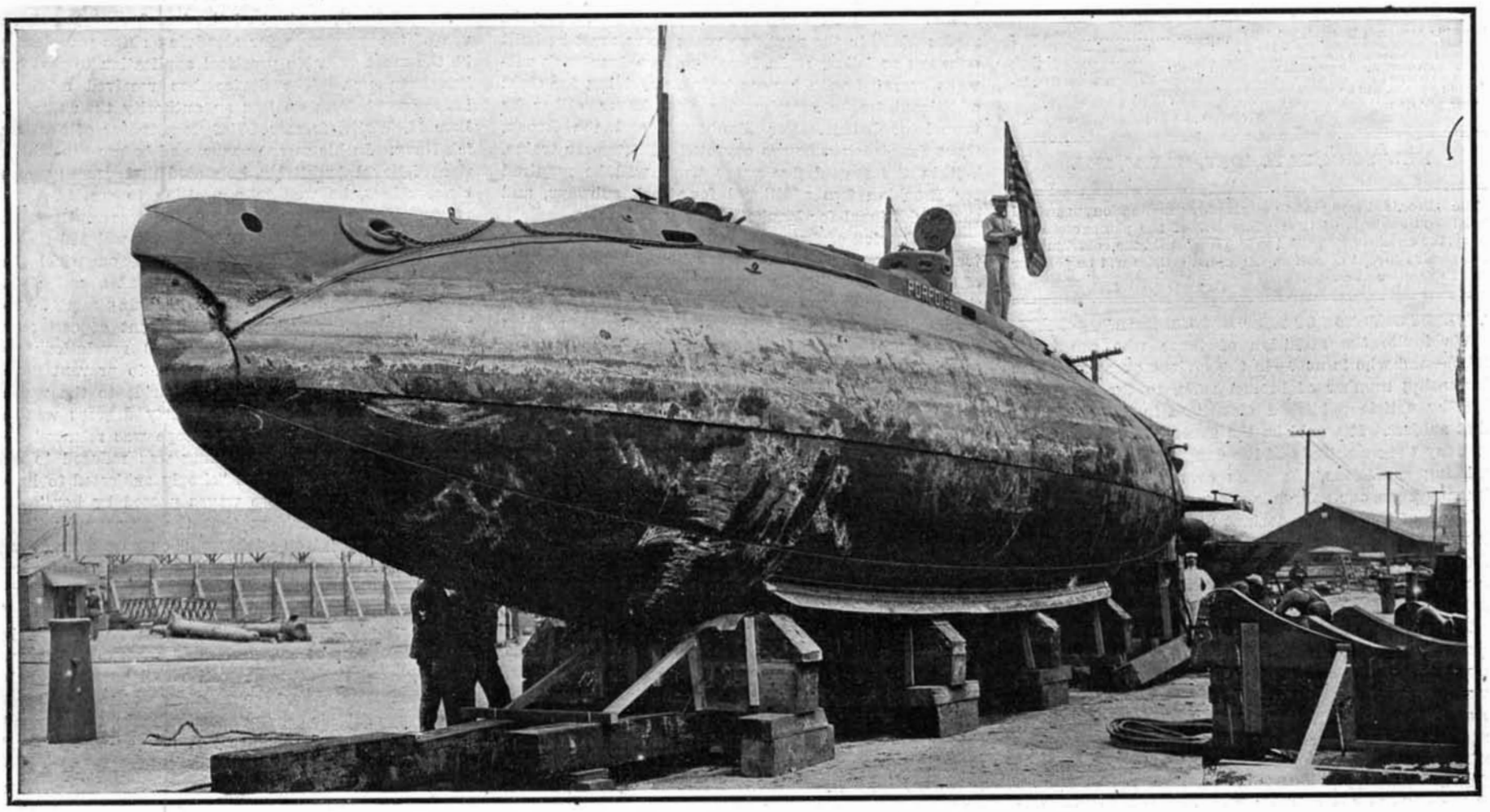
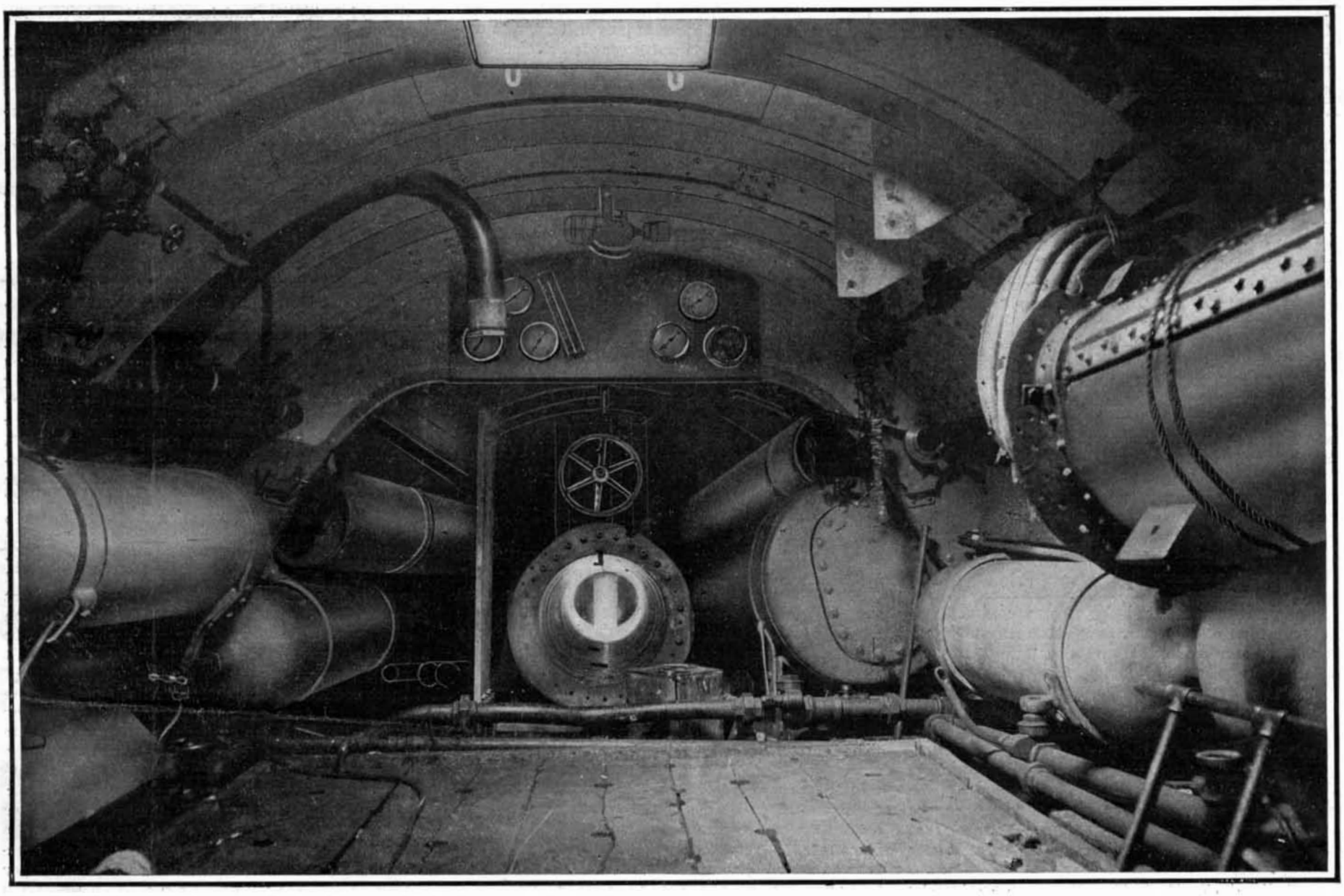


Length, 63 feet. **Diameter.** 12 feet. **Displacement,** Submerged, 120 tons. **Speed,** 5 and 8 knots.

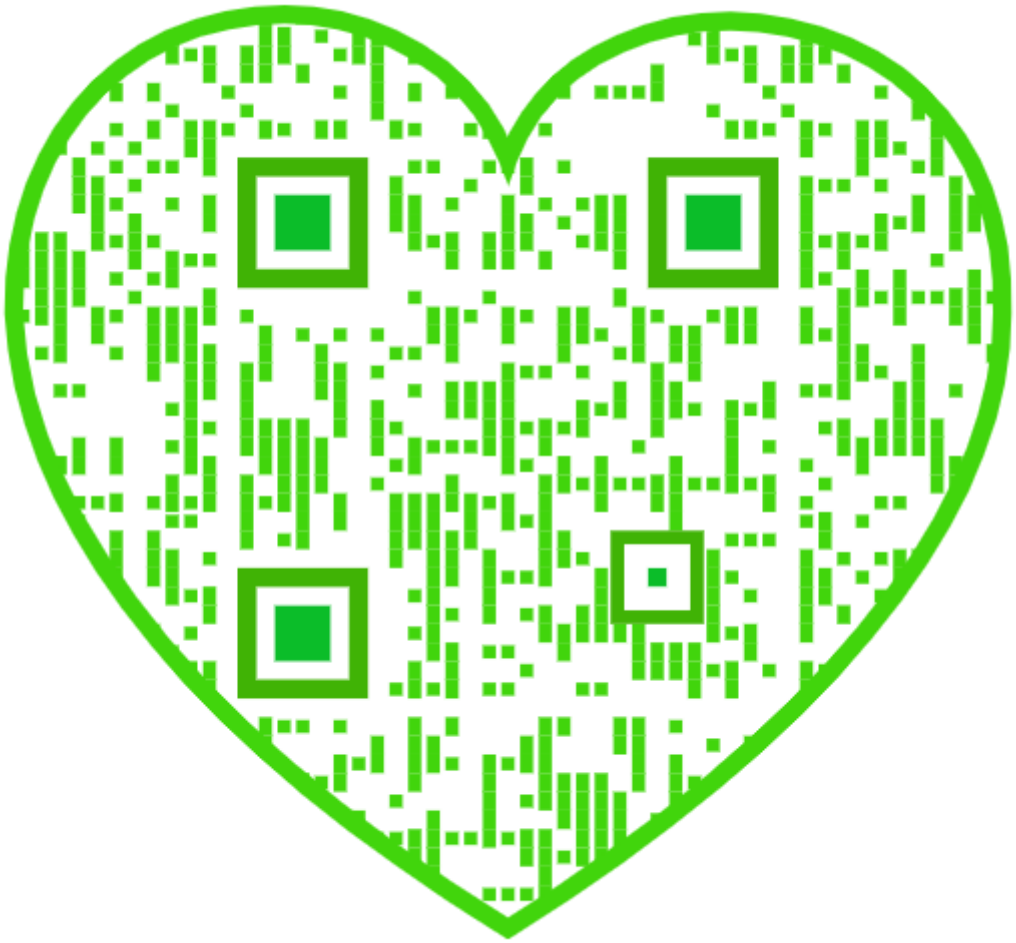
Submarine "Porpoise" on the Ways.



Immediately in the center is the open torpedo tube. Above to the left the pipe from air tank for expelling torpedo. To right and left are air flasks and ballast tanks. Each side of torpedo tube are the forward trimming tanks. Above torpedo tube are pressure, speed, and other gages.

Realistic View in the Interior of a Submarine, Looking Forward.

THE CONSTRUCTION AND HANDLING OF SUBMARINES.—[See page 408.]



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NEW YORK, SATURDAY, MAY 18, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A SPEEDY SOLUTION OF THE "BROKEN RAIL" PROBLEM.

We invite the attention of those who are interested—and who is not?—in the serious question of the increasing number of broken rails, to the somewhat lengthy article published elsewhere in this issue on that subject. It would be the sheerest folly to ignore or deny the magnitude of the danger which, under the existing conditions, threatens everyone who takes a journey upon our railroads. The State Railroad Commission of the most important State in the Union has taken official cognizance of this question; and unless the responsible parties take speedy steps to improve the quality of the rails, the subject is one that may well become the subject of Federal action.

The present conditions are intolerable. Rails have become so unreliable as to constitute a continual menace to the safety of the passengers. The daily papers are filled with accounts of this or that train that has been ditched; and in the majority of cases at the end of the telegraphic account is a brief notice to the effect that the cause was a broken rail. We have shown elsewhere that the deterioration in the quality of the rails is due to the inferior quality of the steel used in their manufacture, and that the inferior quality is due to two facts; first, that the ores of which the steel is being made contain a larger amount than formerly of an impurity which cannot be removed by the Bessemer process; and second, that the manufacturers are using a portion of the steel ingot from which the rails are rolled, which formerly, under the railroad engineers' specification, was rejected as scrap. The engineers claim that the broken rails come chiefly from that portion of the ingot which they used to reject, but which the mills are now incorporating. They also claim that if this portion of the ingot were rejected, it would be possible, in spite of the depreciation in the quality of the ores, to roll a rail which would stand fairly well up to its work. On the other hand, the manufacturers understand that if a one-third crop were used on the ingots, it would mean an immediate and very large reduction in their output, a reduction which, in view of the increasing demands for rails, they are unwilling to make.

Starting from the incontrovertible standpoint that the railroads ought to be provided with the very best and safest rail possible, it would seem that the only and perfectly proper solution of the difficulty would be to make the one-third crop, as requested; roll rails of the very highest character that can be secured under the Bessemer process; and, in order to meet the shortage of the supply that would result from these improvements in manufacture, to remit the duty on steel rails, until such time as the rail-making concerns shall have been able to build and set in operation sufficient Open-Hearth plants to supply the full demands of the country.

THE SUBWAY DEADLOCK IN NEW YORK.

The refusal of the Interborough Company to put in a bid for the new subways, and the failure of any outside bidders to manifest any interest in the question, brings the city face to face with what is perhaps the most serious problem with which it has been confronted in all its existence. Figures prepared by Mr. Rice, Chief Engineer of the Rapid Transit Commission, prove that, unless the work of building new subways be at once put in hand and vigorously prosecuted, the rising tide of population and travel will in a few years have so completely overflowed the lines of travel, that the daily activities of this, the second greatest city in the world, will be at a deadlock.

According to the Rapid Transit figures, as given by their Chief Engineer, the population of Manhattan and the Bronx by the year 1916 will be at least 3,170,000, and the total number of passengers that must be carried will have reached the enormous total of 4,454,800 a day. These figures are based upon the carefully ascertained statistics of the rate of growth of population and travel in the past two years, and Mr. Rice finds that the population of Greater New York has doubled itself every twenty-five years, and will probably double itself again by 1930. He states also that the total passenger traffic, as shown by ticket sales, is increasing at such a rate that it will probably double itself within the comparatively brief period of ten years' time.

From this forecast, which there is every reason to believe is well founded, the Rapid Transit Commission are satisfied that the following provisions must be made: Within the next five years there must be built subways as follows: In Brooklyn, two four-track subways operated with ten-car trains, providing for eight additional tracks crossing the East River, either by tunnel or bridge. For Manhattan and the Bronx, three four-track subways operated with ten-car trains. Within the second five years there will be required for Brooklyn two additional four-track subways, and three additional for Manhattan and the Bronx.

For a period of four years the increase in passenger traffic in Greater New York has been at an even rate of 63,000,000 additional passengers a year, but last year the increase rose to the enormous figure of 110,000,000, presumably as the result of the increased facilities afforded by the opening of the Subway. The increase in the population of Manhattan has been fifteen per cent in the past five years; but the increase of traffic on all lines during the same period has been at the rate of thirty-nine per cent; while in the last five years the increase in the number of long-distance passengers in Manhattan has been 108 per cent, although this last-named increase is not likely to be maintained.

We are satisfied, after a thoughtful perusal of the above estimates, coming as they do from an authority so well qualified to judge, that they are sufficient to warrant our opening statement, that the transportation problem is perhaps the most serious that has confronted the city in the whole period of its existence. The immediate solution lies primarily with the Interborough Company, and it is earnestly to be hoped that, although they are a strictly commercial corporation, and are naturally desirous of securing all the profits that are possible, they will bear in mind that, as regards the contract under which they secured the present Subway, they have been very liberally dealt with by the city, and in no respect more so than in regard to the advertising privileges. The city has shown its desire to meet the Interborough Company halfway in its recent proposal to permit that company to construct additional tracks on the Third Avenue and Second Avenue railways, if they will agree to construct the upper east side and lower west side subways under the terms of the present proposed contracts.

NEW USES FOR AN OLD DEVICE.—THE GYROSCOPIC RAILROAD TRAIN.

The recent very successful tests of Dr. Schlick's gyroscopic apparatus for steadying ships has evidently opened a new field of usefulness for an old device, which for many years was looked upon in no more serious light than that of an interesting scientific toy. Shortly after the first report of Schlick's invention, there came from Germany the announcement of another ingenious application of the gyroscopic principle, namely, its installation on board ship in place of the magnetic compass; and it will be within memory that the tests of this device, as carried out by the German navy, were reported at the time to have been highly successful.

Considerably antedating these two inventions was the appearance of the successful Obry steering gear for torpedoes, in which the tendency of the gyroscope to maintain itself in its plane of rotation was utilized to control the rudder of the torpedo and maintain the latter on a predetermined course. This is the most important improvement effected in the torpedo since the introduction of the hydraulically balanced piston to control the submersion rudders for holding the torpedo at a predetermined depth.

Not always, however, does gyroscopic action lend itself to useful purposes, and indeed, in its larger effects, where the rotating masses are heavy, it may sometimes set up stresses which are apt to be overlooked and may contribute to, if they do not actually cause, disaster. The SCIENTIFIC AMERICAN recently discussed the gyroscopic action of steam turbines in increasing the stresses in the frail hull structure of torpedo boats. The subject was brought up a few months ago by an English naval architect, who proved that in the case of the British torpedo boat whose back was broken when she was plunging heavily into a head sea, the gyroscopic resistance to a change of plane of the revolving parts of the turbine may have amounted to several tons, and that these stresses, being unrecognized at the time the boat was designed, may have carried the total bending and wrenching stresses beyond the limit of strength of the hull.

Another instance of unfavorable gyroscopic action was discussed at the time of the Woodlawn wreck, when it was suggested that the centrifugal force exerted against the outer rail may have been augmented by the gyroscopic resistance of the axles and wheels, and the armatures of the electric locomotive. We believe that no calculation of this effect was made at the time the locomotives were designed; and in view of the novelty of such an investigation, the oversight must be considered as entirely pardonable. Subsequently to the wreck, the problem was worked out, and it was found that the gyroscopic effect would add about five per cent to the thrust resulting from centrifugal action of the whole locomotive.

Judged by the extent of the benefits conferred, the use of the gyroscope for steadying ships promises to be the most valuable practical application to which it has been put. The device has received a strong indorsement from no less an authority than Sir William H. White, former Chief Constructor of the British Navy. In his recent paper read before the Institution of Naval Architects, he stated that, from personal observations, he was in a position to certify to the remarkable steadying effect of the gyroscope. These observations were made on board a vessel 116 feet in length and of 56 tons displacement, on which the gyroscope was fitted in a compartment ahead of the boiler room, the axis of the device being carried in a vertical plane. At the commencement of each test, with the flywheel running at 1,600 revolutions per minute, and the gyroscope clamped to prevent movement, the vessel was placed broadside to the waves, and a total arc of rolling of thirty degrees was recorded. Immediately the gyroscope was released and came into operation, the rolling was reduced to one degree, and the vessel was "simply subjected to heaving motion as successive waves passed by her." Sir William White considers that the gyroscope will be particularly useful on yachts and on passenger steamers employed on coasting and cross-channel services. He states that he has investigated this problem for typical vessels now in service, and feels confident that remarkable steadiness can be assured by the installation of gyroscopes of moderate size and weight, requiring comparatively small power for driving them. Because of the great size of modern ocean steamers and their consequent steadiness, the demands for such an apparatus are not so urgent; although steadying apparatus might be introduced to good effect even here. For warships, the possible applications of the device are numerous; and the advantages of securing a steady gun platform are already well known. The tendency, of late, to build warships of great metacentric height will probably tend to shorter periods of oscillation, and in correcting this tendency the gyroscope may be found to possess value.

Judged from the standpoint of its curious interest, however, it must be admitted that the most original proposal to apply the gyroscope to practical purposes is that of Mr. Louis Brennan, the inventor of the Brennan torpedo, who would use the device to maintain a full-sized railroad train in the vertical position while it is traveling upon a single rail laid upon the surface of the ground. According to the cable dispatches, Mr. Brennan's device appears, strange to say, to have had sufficient practical merit to warrant its rather lengthy exploitation under the auspices of the Royal Society of London, a model built on a scale of one-eighth full size having been shown in operation. It is, of course, a far cry from a model to a structure of the size and weight of a modern railroad train; and at the first blush it would seem as though the weight of gyroscopes of the size necessary to impart the required stability would be so great as to rob the invention of all practical utility. According to the inventor, the weight of the apparatus works out at only five per cent of the total load; or say, about three tons for a sixty-ton Pullman car. If this be the case, it is certain that the flywheel must be run at an enormous speed—a speed so high that it becomes a matter of speculation as to what kind of metal can be found to withstand the enormous centrifugal stresses that would be involved. Furthermore, it must be remembered that a failure of the rotating mechanism would mean the loss of all stability by the train; and that just here, in the unlikely event that the invention should prove to be mechanically practicable, would be a constant source of peril, which might well detract from its popularity with the traveling public.

Another difficulty which suggests itself is the action of centrifugal force upon the passengers in rounding curves at the 120 miles an hour speed proposed. The car would incline to the outside of the curve at an angle which would be the resultant of the pull of centrifugal force against the resistance of the gyroscope; but the living freight would be thrown even farther off the vertical. But perhaps the scheme involves the provision of some ingenious form of "pocket" gyroscope to be "carried conveniently" on the person; or it may be that the promoters are satisfied that those who would trust themselves to such means of travel already carry sufficient "wheels" in the head to secure all the desired gyroscopic effects.

THIRD ANNUAL MEETING AND RUN OF THE AUTOMOBILE ENGINEERS.

The third annual meeting and test run of the mechanical branch of the Association of Licensed Automobile Manufacturers was held last week at Hartford, Conn., in which city is located the testing laboratory of the association.

The previous meetings of the mechanical branch have resulted in the adoption of standard sizes of screws and screw threads for use in automobile construction as well as standard sizes of tires. At this latest meeting, arrangements were made looking toward the adoption of a standard rim for quickly detachable tires. A committee was also appointed to meet with the board of underwriters of the fire insurance companies and adopt regulations and specifications for garages that would not be so obnoxious and onerous to the owners as those now in force.

The resolution which will be most widely appreciated by all owners of cars and those in the automobile industry, however, was that adopting as a standard formula for the determination of horse-power the following:

$$\frac{D^2 \times N}{2.5}$$

in which D = diameter of cylinders in inches, and N the number of cylinders, 2.5 being a constant. This is the formula used by the Automobile Club of Great Britain and Ireland, and a thorough testing of it has shown it to be remarkably accurate. All licensed cars will be rated under this formula, and this will do away with the useless double rating, which, in some of the new State laws, is made use of for increasing the tax when the horse-power is used as a basis. The formula gives the horse-power that any standard engine will develop at a normal speed of around 1,000 revolutions per minute. The various makers decided to send engines to Hartford to be tested in the laboratory of the association.

A very interesting paper on "Radiation" was read by Mr. Edward R. Hewitt, who discussed this subject from both the theoretical and practical standpoint. Talks on "Lubrication" were also given by representatives of several companies that manufacture mechanical oilers.

The run on the 10th instant was for the purpose of giving the engineers an idea of what their competitors' cars could do on the road. A trip of 30 miles south along the Connecticut River on the west side was made, the cars being ferried across at East Haddam, and making the return journey on the east side. Some steep hills were encountered upon the return trip, but no difficulty was experienced by any of the cars in climbing them. A notable feature of the run, in contrast with what would have been the case as late probably as three years ago, was that nothing whatever had to be done to the cars when the stop was made for dinner. Neither were there any breakdowns on the road. There were four controls in the trip of 62 miles, and the engineers changed cars at each control. All types of present-day, high-grade American cars were found among the twenty-one cars that participated. Our Editor rode in the new 8-cylinder Hewitt machine over the most hilly part of the route, and he was much impressed with the smooth-running qualities of this new type of motor and the ease with which it pulled the car up the hills. A Franklin air-cooled touring car was the only representative of the 6-cylinder type. Altogether, some seventy-five engineers and technical men participated in the run.

From a 209-mile endurance test between Harrisburg and York, Pa., which was conducted on May 6 and 7 by the Motor Club of Harrisburg, but four cars emerged with perfect scores. These were a 35-horse-power Pierce Arrow, a 40-horse-power Pullman, a 60-horse-power Thomas, and a 30-horse-power White steam car. The cars were obliged to make an average speed of about 20 miles an hour, which was readily done in the first day's run of 93 miles, since the roads, although good, bad, and indifferent, were dry. The second day it rained, and many of the fifteen cars that made a perfect score the first day lost it in the 40-mile run to York, which had to be made over a very muddy road in two hours. Thirty-one cars participated in this test.

The New York Motor Club will hold a 200-mile endurance run in one day on June 6. This is the longest run for a single day ever made in any endurance test in this country.

On June 19 the Automobile Club of America will start a 600-mile endurance run extending over four days. This is to be known as a "sealed bonnet" contest. The bonnets, transmission gear cases, etc., will all be sealed, thus making it impossible to make any repairs without breaking a seal. If this is done, the car is out of the contest. There are to be three classes —A, B, and C, the first being for stock cars without tops listed at $3,000 and over, the second for cars listed at $1,500 and less than $3,000, and the third for those listed at $1,500 and under. The minimum average speeds that must be made by cars in the three classes are 18, 16, and 14 miles an hour respectively. The runabouts in class A will be required to cover a total distance of 700 miles.

NEW COMMISSIONER OF PATENTS.

It is with much regret that we have to announce the resignation of Mr. Frederick I. Allen, who has been the Commissioner of Patents since 1901.

During Mr. Allen's administration the work of reclassification has been persistently carried forward. The Commissioner has had many difficulties to contend with in the many changes which have occurred in the Patent Office force during his incumbency.

The inventors of the country are to be congratulated that his successor is a man who was raised to this most important post within the gift of our government, not through any political influence, but because he has been recognized as the man best fitted professionally and by training for the position. Mr. Edward B. Moore, the newly-appointed Commissioner of Patents, is neither a theorist nor a doctrinaire. He is a man whose schooling has been received within the walls of the Patent Office. He has risen through the grades of Assistant Examiner, Law Clerk, Primary Examiner, and Examiner-in-Chief.

He was at one time head of the Interference Division, and has for several years acted in the capacity of Assistant Commissioner of Patents. This splendid training eminently fits him for the higher post which he now occupies.

His dominant qualities are those of fair-mindedness, with a highly judicial mind and an understanding of the technical side of the profession which he has for a long time embellished. He has a full knowledge of

MR. EDWARD B. MOORE, THE NEW COMMISSIONER OF PATENTS.

the defects and shortcomings in our patent system and within the Patent Office. It would be difficult to find a more available candidate for carrying out the work of the Department.

Mr. Moore was born at Grand Rapids, Mich., and entered the Patent Office in 1883.

FLIGHTS BY HOMING PIGEONS.

There exists in this country an association for racing homing pigeons, and races are frequently held throughout the summer months. The birds are shipped in crates by express to the various starting points, and there liberated at the appointed time. Each flies to its home, and, upon alighting, registers its time of arrival. The owner of the bird has to remove from its leg a small metal piece, and deposit it in a slot in the registering apparatus, thus unlocking it, before the registration can be made. Sometimes a long-distance race is won by a few seconds only. The distances are carefully measured from the starting point to each loft, and the average speeds of the birds are figured out very closely. The average speed of these birds in flights up to 500 miles in length is 46½ miles an hour. The following table gives the records for the different distances:

Distance. Miles.	Speed. Miles an hour.
100	85.63
200	64
300	63
400	58
500	54
600	44
700	52.73
836	17.38
1,000	4.14

The last two flights, the longest on record, were made in 2 days and 11 minutes and 5 days, 1 hour, 22 minutes, respectively.

About 20 per cent of the old birds that start in a 500-mile race never show up, while the loss of young birds in a 100-mile race is about 17 per cent. The birds are trained by taking them a certain distance away from home and releasing them. This is done a number of times, the distance being each time increased.

SCIENCE NOTES.

Intimation concerning two new species of animals, indigenous to Africa, has been conveyed to Europe by Mr. J. E. Speares, who has been spending several months in trapping and hunting big game in Portuguese East Africa in the regions surrounding Lake Nangadi and the Rovuma River. One of these refers to a new type of zebra, a whole herd of which the hunter observed near by, but a specimen of which he failed to secure. Many members of this herd were marked differently to the prevailing type of this animal, the heads and necks being brown, while the hindquarters were striped in the conventional manner peculiar to this quadruped. When the natives were questioned upon the point, they asserted that they were a variety of zebra, but that they were becoming very scarce. Although the hunter pursued the herd for several miles, owing to their agility and timidity, he was unable to approach them closely. Upon another occasion, however, he was more fortunate and secured a closer view of the animal. It resembles the zebra in shape, but the head, neck, fore-legs, and fore half of the body were quite dark brown in color, the hind part of the body, including the legs, being striped. He also discovered a peculiar type of antelope similar in size and shape to the Boer roebuck or impala, the distinctive difference being a black line down the center of the back and on either hind leg down to the foot. When the animal is startled it immediately takes to flight, the initial leap being fully ten feet through the air. This species of antelope is essentially gregarious, being found in herds ranging from ten to fifty in number, and is exceedingly wild and active. Mr. Speares also secured what is believed to be a new species of buck, which is perfectly hornless, about as large as a steenbuck, and possessing a brilliant red coat.

A discovery of remarkable Egyptological interest has been made by Mr. Theodore M. Davis at Thebes, by the excavation of the tomb of Queen Teie, one of the greatest names in ancient Egyptian history, since she was the mother of the famous Amen-hotep IV., the heretic king of the eighteenth dynasty. The tomb of this royal personage was found to bear the marks of the religious zealots, who carefully removed therefrom every trace of the peculiar pantheistic monotheism she endeavored to introduce into the country. The doorway, consisting of piled stones sealed with the royal seal, was found to have been broken down, the huge wooden doors torn from their hinges, the catafalque torn to pieces, and the mummified corpse itself turned over in order to erase the name of Amen-hotep IV., which was originally inscribed on the sheet of gold upon which the body reposed. When excavated the tomb was found to still bear all these traces of the zeal of the religionists, effected during the period in which the country was in the throes of a religious revolution long before the time of Moses. The excavators found the tomb virtually lined with gold leaf, and fragments of gold were found on all sides. The coffin reposed upon a bier incrusted with gold, and was supported by four lions' paws, which were of the same precious metal. The coffin was perfectly intact, and is stated to be a magnificent specimen of the ancient Egyptian jeweler's handicraft. The wood of the coffin is entirely covered with a frame of gold inlaid with lapis lazuli, carnelian, and green glass. There is a hieroglyphic inscription upon the metal plate, to the effect that the coffin was prepared for Queen Teie by her son. The mummy itself was enwrapped from head to foot in sheets of gold, with bracelets on the arms and a necklace of gold beads and other ornaments executed in the same metal around the neck, while the head was encircled by a priceless object—the imperial crown of the queens of ancient Egypt. The crown, though of simple design, is of magnificent workmanship, depicting the royal vulture holding a signet ring in either talon, while its wings surround the head and by means of a pin are fastened at the tips, the whole article being fashioned in solid gold without any additional embellishment. This discovery is considered to be one of the most important from an archeological point of view that has been made in Egypt during recent years, affording as it does a priceless relic of the barbarous ornamentation and love of jewel embellishment which prevailed among the earliest Egyptians.

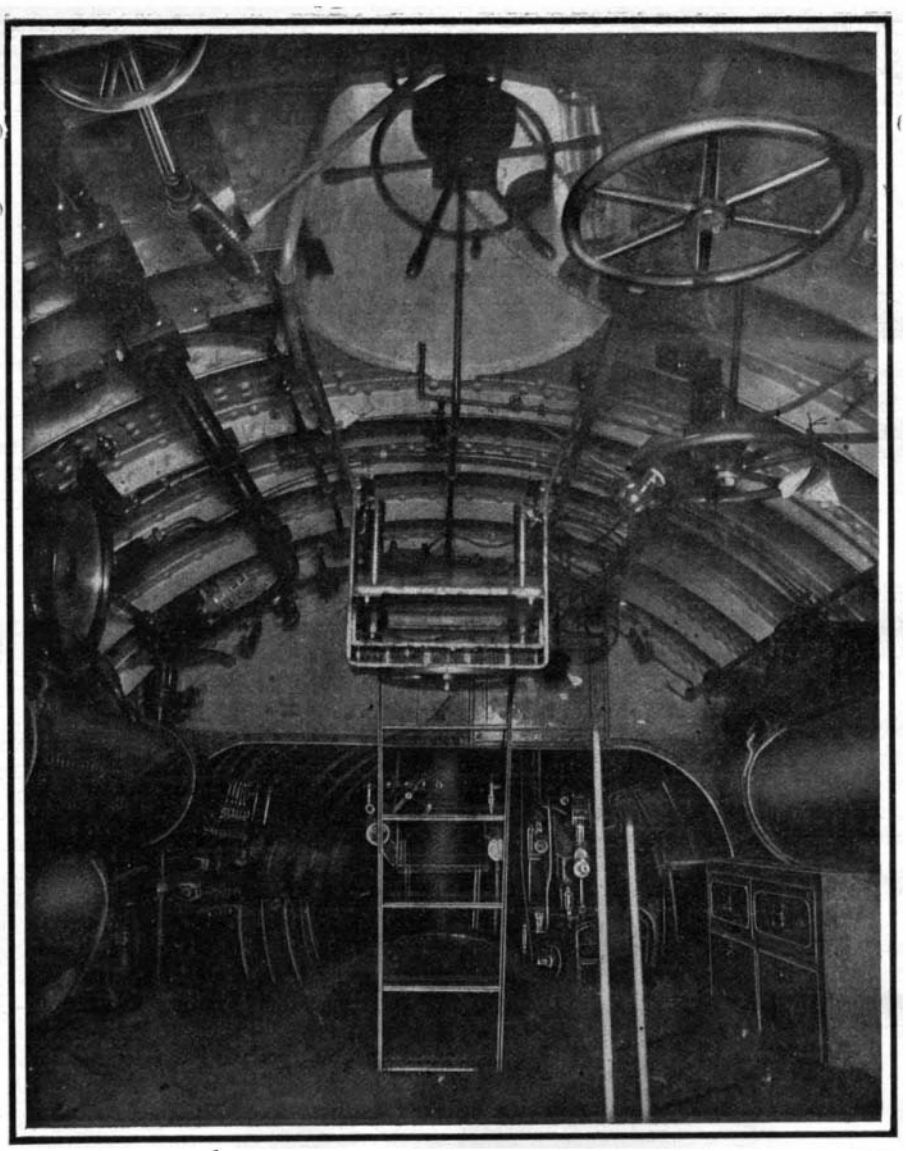
Waterproof Porcelain Cement.—Dissolve (I.) 10 parts of mastic in 60 parts of anhydrous (absolute) alcohol, (II.) 20 parts of isinglass in 100 parts of water and 10 parts of grain spirit, (III.) 5 parts of gum ammoniac in 25 parts of grain spirit. Thoroughly mix solutions I. and II., then add solution III. and boil the whole down to 180 parts.

THE CONSTRUCTION AND HANDLING OF SUBMARINES.

BY WALTER BERNARD.

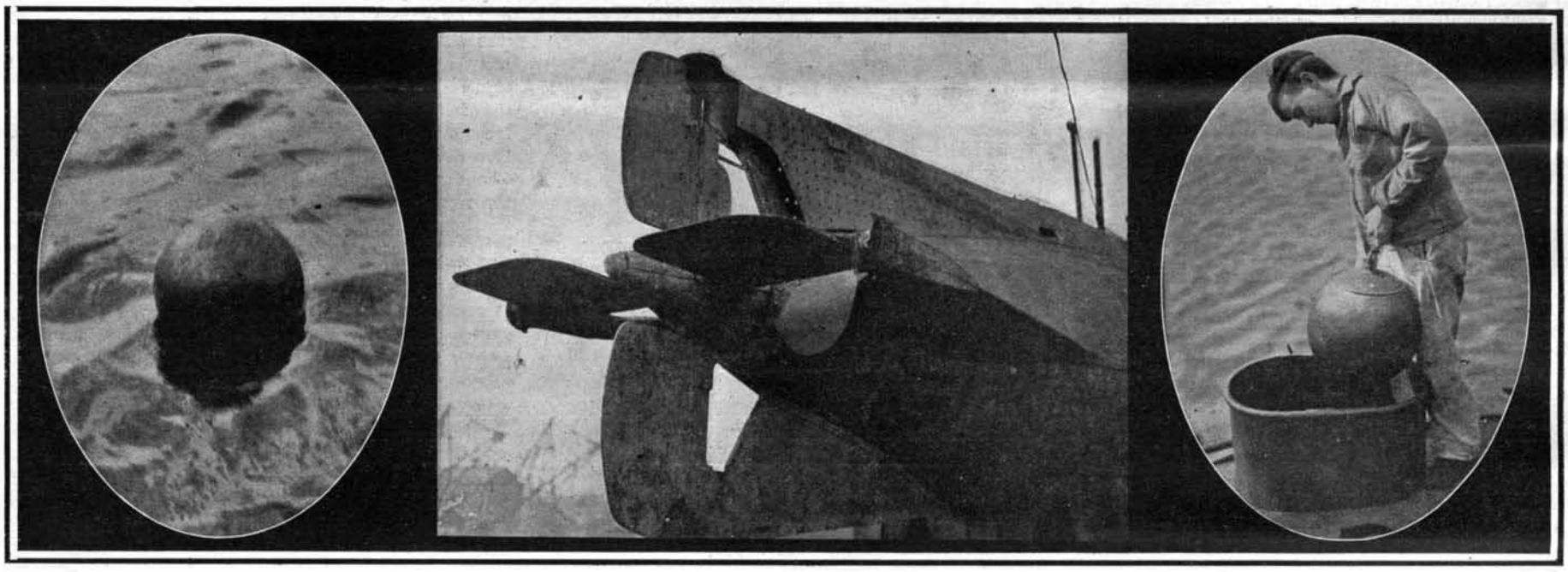
Attention is called to the subject of submarines by the competitive trials now being carried out by the government at Newport. Of the two main classes of American submarines of the diving and even-keel type, the former has been adopted by our navy. The present trials at Newport are being held between the Holland and Lake types. The eight submarine boats now in service are 63 feet long and 12 feet in their greatest diameter, and have a displacement when awash of 105 tons, and when submerged of 120. The four new and larger ones which have just been finished, viz., the "Cuttlefish," "Tarantula," "Viper," and "Octopus," the last named now being tested at Newport, are 105 feet long and 200 tons displacement. These are equipped with more powerful engines, motors, and other improved mechanisms; but in general shape, the scheme of construction, with slight modifications, follows that of the earlier boats such as the "Plunger," "Shark," "Porpoise," etc. They are of greater structural strength and said to be able to stand the pressure of being submerged 300 feet, though 200 is the official depth required at the Newport trials. The "Octopus" is supplied with a new system of submarine bell signals, whereby communication can be had with the surface. The radius of action is about 100 miles from base. She is equipped for warfare with two 18-inch torpedo tubes. Submergence is accomplished through the filling of the various ballast tanks, which include the forward and after trimming tanks, a midship tank, main ballast tank, and several auxiliary ballast tanks, which are distributed in various parts of the boat. The "Octopus" carries very little reserve buoyancy, about 800 pounds, and submerges by pointing the bow down about 8 deg., using the horizontal rudder for this purpose. To maintain submergence after reaching the desired depth, the bow remains pointed down about 3 deg., with slight variations in each boat. In making ready for diving, the boat is trimmed down by the head; and after having filled the trimming tanks to the required extent, so as to leave the amount of positive buoyancy required, about 800 pounds, the craft is in shape for the plunge. As the craft gains headway, the diving rudder is put down, and the vessel dives. The depth, registered on a scale, is regulated by the diving rudder. To maintain submergence after arriving at the proper depth, a man has to receive special training in operating the diving rudder. To return to the surface, the amidship tank is first blown. This holds 1,000 pounds of water, which is forced out under ordinary circumstances in five seconds, by means of compressed air. Another vital interior feature, both for breathing purposes and motive power, is the compressed-air system. The air is stored in a series of 2,000-pound flasks and other lesser ones. The latter are used for firing torpedoes and for blowing out the tanks. The motive power is a powerful gasoline engine for surface running and an electric motor for submerged running. The speed is from 11 to 12 knots on the surface, and about 9 knots when submerged. The stor-

(*Continued on page* 410.)



In the roof is the conning tower with the steering wheel; to the right the inside tiller wheel; below that the wheel to operate diving rudders; aft of the ladder are the engines; to the left are depth gage and air and ballast tanks.

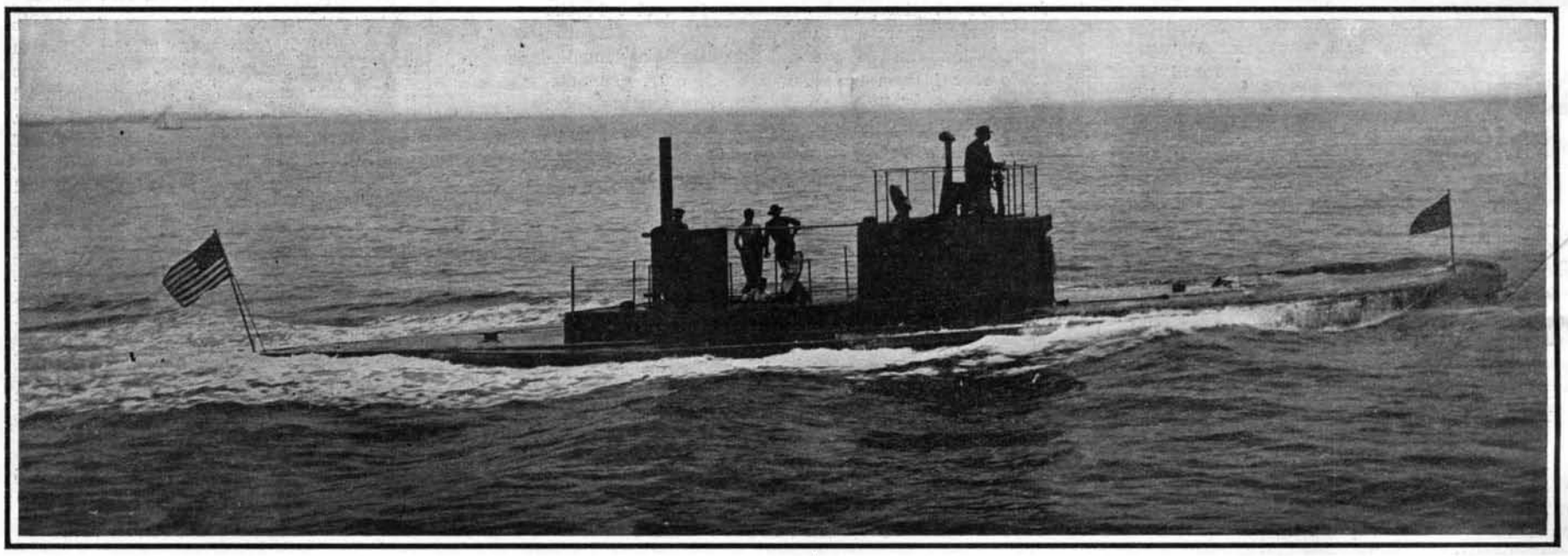
Submarine Interior, Looking Aft.



Hollow Copper Signal Buoy Containing a Telephone Receiver for Communication With the Submarine.

Stern of a Submarine, Showing the Horizontal Diving Rudders, the Steering Rudders, and the Propeller.

Signal Buoy Attached by Wire, Released from Inside Submarine, Rises to Surface to Locate Submarine.



Length, 85 feet. **Displacement,** 250 tons. **Speed,** 10 knots on surface. Submerges on an even keel. In emergency can release a 5-ton keel and rise to the surface.

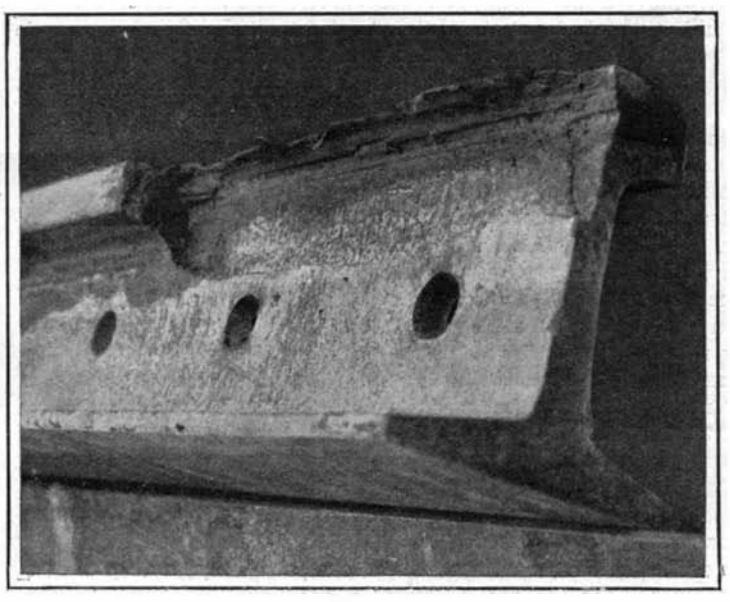
THE TWIN-SCREW LAKE SUBMARINE.

THE PERIL OF THE "BROKEN RAIL"—ITS CAUSE AND CURE.

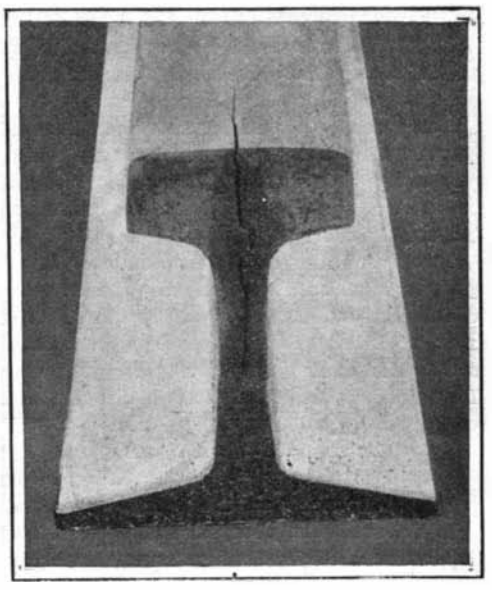
There is nothing to be lost and much to be gained by giving full publicity to any grave peril which threatens the public safety. Among such is to be reckoned the recent alarming increase in the breakage of steel rails on the railroads of the United States. The present crisis was foreseen and foretold years ago by the engineers of the railroads; it is recognized by the rail-makers themselves; and it has been brought forcibly to the public attention in the report recently published by the State Railroad Commission of the State of New York. In this document, which covers the winter months of 1905-6-7, the alarming fact is revealed that the number of broken rails removed from the tracks amounted in 1905 to 1,178, in 1906 to 804, and in 1907 to 2,899, the increase of the number in 1907 over those in 1906 being therefore 360 per cent.

The SCIENTIFIC AMERICAN has recently made a careful investigation of the subject, in the course of which every facility was afforded, both by the engineers of our largest railroad companies and by the leading manufacturers of steel rails. The investigation was made by the Editor in person; and he was given exceptional facilities for examining the private records of the railroads, and the minutest details of the process of manufacture by the rail mills; and he takes this opportunity of acknowledging the courtesies extended.

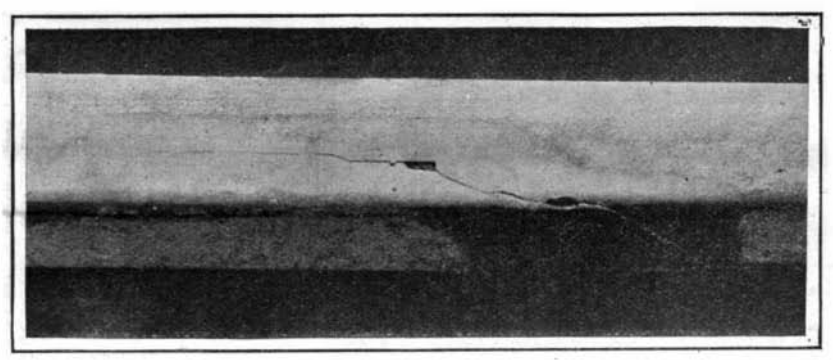
That there has been a decided increase in the breakage of rails during the past six or seven years, and that this increase is unnecessary and could be avoided by proper methods of manufacture, is the claim of the railroads. The rail-makers admit that breakages have increased; but they attribute it, not to faulty methods of manufacture, but to the great increase which has been made in the weight of the rolling stock and the higher speeds at which the trains are run; and they suggest that the railroads should adopt rails of a heavier section in order to meet the heavier stresses imposed by modern traffic. To this the railroads reply that what is needed is not heavier rail sections but better material; and in proof of this, they point to the fact that even after the weight of the rails had been raised from 80 pounds to 100 pounds per yard, the increase in breakages continued to rise at an accelerated rate.



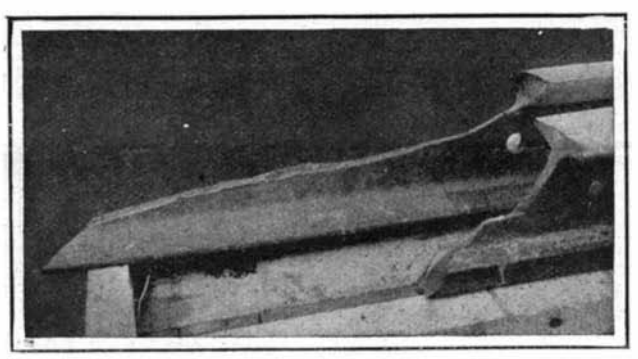
Fracture Due to a "Pipe" and Segregated Material. The Most Dreaded Form of Break; Generally Derails the Train, the Flange of the Wheels Climbing the Rail at the End of the Break.



"Piped" Rail. This Fissure is Frequently Invisible in the New Rail, Being Hidden in Its Interior and Only Disclosed as the Rail Becomes Worn.



Showing How Fragments Break Out from Side of Head. Due to Flaws Carried Over from Ingot.

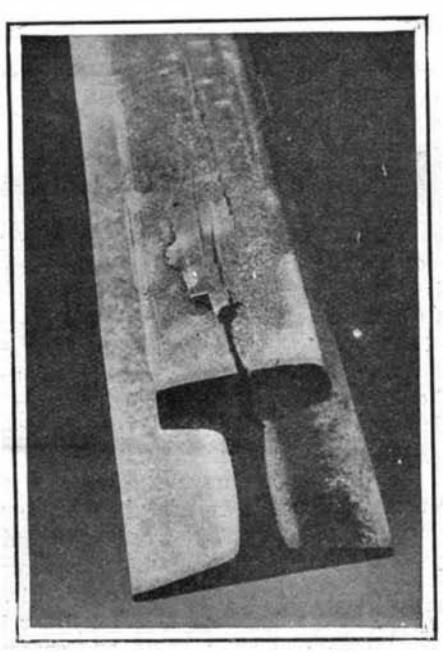


Long Breaks Commencing in Base of Rail, and Extending Diagonally to the Head.

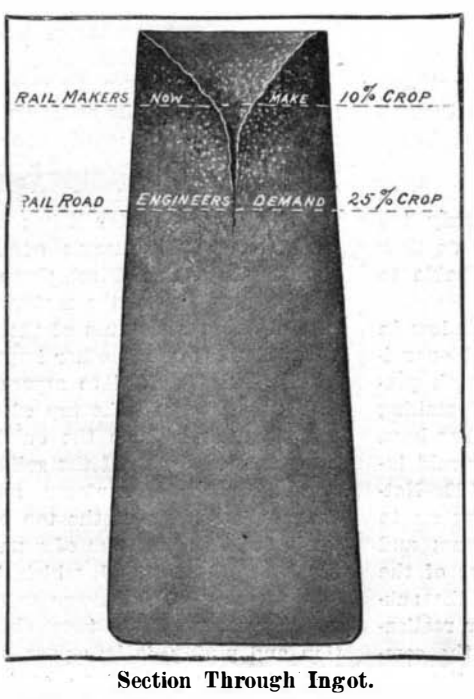
The engineers of the railroads state that they are anxious to secure rails only of the very highest quality, and that, if it should be shown to be necessary, they are willing to pay the higher price which may be demanded for producing a rail of the desired composition, strength, and wearing qualities. The manufacturers, on the other hand, emphatically declare that *subject to the present conditions imposed by the limitations of the Bessemer process and by the necessity of running their mills at the fullest capacity in order to meet the enormous demand*, they are making the very best possible rail that can be produced. After a careful inspection of one of the largest rail mills in the country, we are satisfied that, subject to the conditions given in italics above, the manufacturers are making about as good a rail as they can.

A few years ago, the failure of rails was not more frequent than might be expected in a steel structure subjected to such extraordinarily severe usage as this important member. At that time it was customary, at least on the more important railroads, for the engineers to prepare their own specifications, and these were accepted by the manufacturers, who gave with each contract a guarantee. As long as these specifications prevailed, an excellent quality of rail was secured. But some six or seven years ago, and about the time of the amalgamation of the steel interests, the manufacturers began to show a restlessness under the existing conditions, and the information was sent out that they could no longer accept the specifications of the railroads, but that because of certain exigencies which had arisen in the railmaking situation, modifications were necessary in the specifications, especially as affecting the composition of the metal. The engineers' specifications had to give way to those prepared by the manufacturers. This was followed, later, by a refusal of any further guarantee. The result, it is claimed by the railroads, has been that an inferior quality of rail has been furnished, and that breakages have increased correspondingly. We are satisfied that the fundamental causes of the present trouble are to be found in the fact that the best quality of ore suitable for the Bessemer process has been exhausted, the present ranges yielding ores which under the Bessemer process are highly unfavorable to the production of the quality of steel desired, and to the further fact that to produce high-quality rails would so greatly limit the output of the rail mills of the country, that they could not possibly keep pace with the demand. Rail-makers start out with the proposition that they must run their mills at a sufficient speed to meet this demand; and they claim, and we believe the claim is made in all honesty and in accordance with the facts, that subject to this proposition, they are turning out as good a rail as the rapid methods of manufacture allow. With the above facts in mind, a brief statement of the conditions of rail making as carried out formerly and to-day will, we think, make the question clear to our readers.

It may safely be said that there is no material in the whole field of steel manufacture, with the exception of armor plate and projectiles, which is subjected to such severe, such absolutely brutal treatment, as the steel rail, enduring as it does every imaginable kind of stress. Its material is subjected to terrific tension and compression. It is alternately bent, twisted, and hammered; and many of these stresses are successively and rapidly applied in the reverse direction. The principal desirable qualities in a rail are hardness to resist crushing and abrasion, and toughness to resist fracture. As we now shall endeavor to show, it has been in the endeavor to secure both of these qualities, that many of the difficulties of the present situation are to be found. Briefly stated, the process of making Bessemer steel rails includes, first, the recovery of the iron from the ore by smelting in a furnace; second, the removal of all of the carbon and as much of the other undesirable constituents as possible by "blowing" in a converter, where these elements are burnt out of the metal as streams of air are forced through it; third, the introduction into the blown metal of the percentage of carbon desired; fourth, the casting of the treated metal, which is now Bessemer steel, into an ingot; and last, the rolling of the ingot

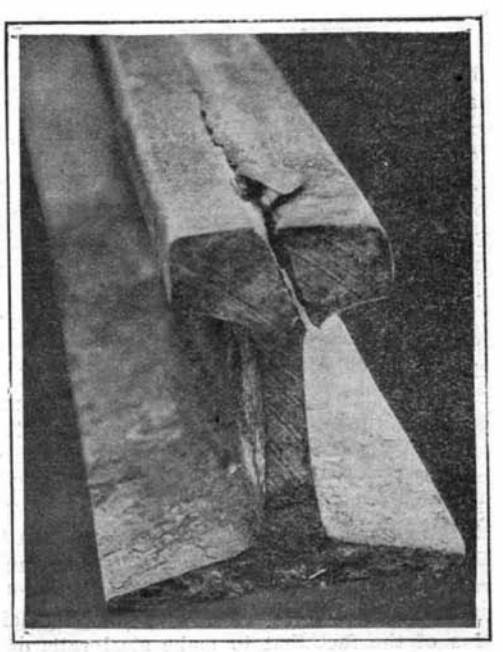


A "Pipe" in the Head of the Rail Started This Fracture. Note Fibrous Structure.



Section Through Ingot.

Impurities and "pipes" form at top of ingot. 25 per cent should be entirely cut off as scrap.



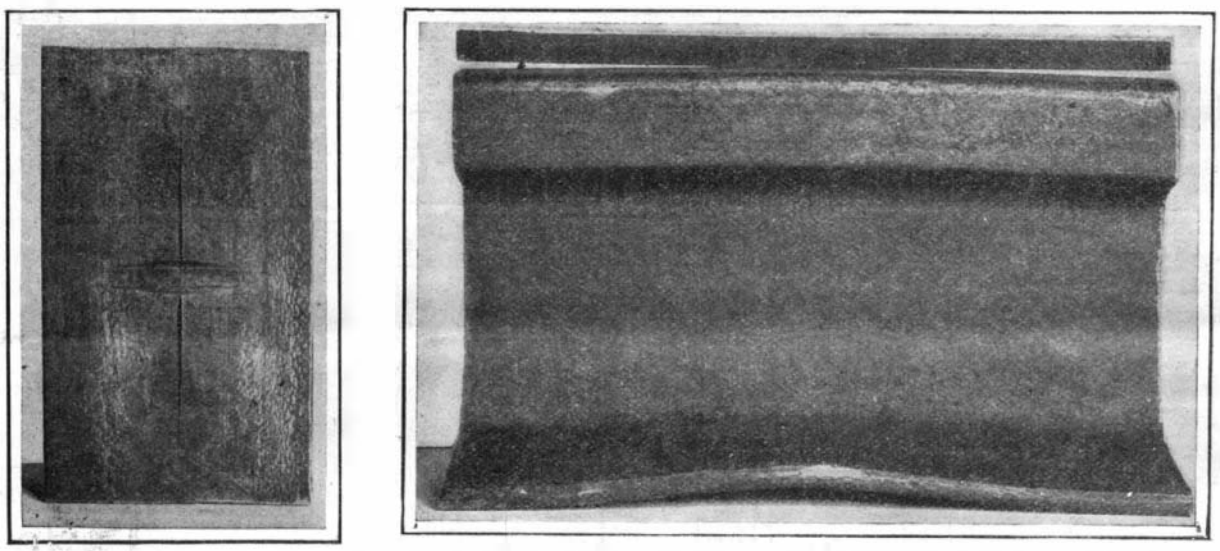
One Half of the Head of Rail Split Away Along the Line of an Old "Pipe."

down into the finished steel rail. The chemical composition of the steel is determined by the treatment in the converter; where, as above stated, the undesirable elements in the iron are removed, or, as far as possible, reduced in percentage. The impurity which causes the most trouble by producing brittleness in a rail is the phosphorus. But, unfortunately, the phosphorus cannot be removed by the Bessemer process; and, consequently, the percentage which exists in the ore will be found in the finished rail. The carbon, which is the principal hardening element in the rail, can be perfectly controlled. It can be entirely burnt out in the process of blowing, and the desired percentage reintroduced by pouring a certain amount of molten spiegeleisen into the converter after the blowing is over.

By way of illustrating the composition which would give an ideal rail, we will take the case of some rails which were rolled under the specifications of an engineer of international reputation, who has given his whole life to the study of this particular question. These rails were rolled at a leading mill in Pennsylvania, between the years 1897 and 1898:

Carbon = 0.60 to 0.65 per cent.
Phosphorus = not over 0.06 per cent.
Manganese = 1.10 to 1.30 per cent.

In this rail the phosphorus is exceedingly low and the carbon is high; thus securing, as far as the chemical composition is concerned, a rail that combines hardness with toughness. These rails have exhibited magnificent wearing qualities. Some of them, which were laid at the entrance to one of the biggest and busiest terminal stations in this country as long as twelve years ago, have, in the interim, carried a traffic of 350,000,000 tons. Yet in all these years they have shown a wear of only 3/32 of an inch on the head of the rail; and all the joints are to-day in perfect condition. Although this particular lot of rails was of exceptionally high quality, it may be said that the average rails of that period, rolled to the specifications of the engineers of the railroads, were, in a general way, of the same hardness, toughness, and durability. Now, let us compare the composition of those rails with that of the typical rail which is being rolled to-day under the specifications of the manufacturers. The following table shows the composition adopted by agreement among the manufacturers themselves; and it represents the composition of the rails which have been breaking so badly during the past winter, photographs of several of which, taken as they lay along the side of the tracks, are shown in the accompanying illustrations.



Bottom View and Side Elevation of a Rail Tested to Destruction in Testing Machine to Show the Effect of Bending a Rail Across a Tie. This Occurs When a Heavy Wheel Load Bears on the Rail on Each Side of a Well-Tamped Tie. The Effect is Frequently a Break in the Base of the Rail, Starting, as Shown, in a Longitudinal Fracture. Manufacturers Claim That Most Breaks Occur in This Way; Engineers Claim That "Piping" is the Chief Cause.

Carbon = 0.50 per cent.
Phosphorus = not over 0.10 per cent.
Manganese = 0.80 to 1.10 per cent.

Comparing this composition with that of the earlier rails, it will be seen that the phosphorus has been raised from 0.06 to 0.10 per cent, an increase of over 60 per cent. This increase is one of the chief causes of the brittleness of the present rails. The phosphorus is present, not because of any wish of the makers to raise the percentage, but because the low-phosphorus ores have been pretty well exhausted from the mines, and a grade of ore has been reached which is high in phosphorus. The manufacturers would be only too glad to reduce this percentage; but as long as they use the Bessemer process, they are quite unable to do so.

The only method known by which steel rails low in phosphorus can be made in large commercial quantities and at a moderate price is the open-hearth process. But the number of open-hearth rail-making plants in the country is very limited, and it has been estimated that to put in open-hearth plants would involve first and last an outlay of over $60,000,000. Naturally, manufacturers are desirous of holding on to the Bessemer process in spite of its limitations; and there seems to be little doubt that the cause of the rejection of the engineers' specification and the substitution of their own, is to be found in their realization of the fact that to make steel rails of the combined hardness and toughness demanded by the railroads is no longer possible with low-grade ores under the Bessemer process. When the quality of the ores coming from the mines began to depreciate, showing high phosphorus, the rail mills attempted to meet the difficulty by lowering the percentage of carbon, and for a while they succeeded in turning out rails which were tough enough not to break under winter traffic and heavy load. But these rails proved to be deficient in hardness. They battered down badly and wore away quickly on the curves. In answer to the demands of the railroads, for harder rails, they raised the percentage of carbon; but although they furnished a rail of sufficient hardness, the high carbon and the high phosphorus together gave too brittle a rail, and hence the enormous failure of nearly 3,000 rails in three months in this State alone during the past winter.

So much for the question of the composition of the rail, which, after all, is scarcely more important than the question of its mechanical treatment in the process of casting and rolling. There is no denying that the rail mills have lately been up against a very hard proposition; for not only have they been trying to make tough rails from high-phosphorus ores by a process that was never intended for such a purpose; but they have been confronted by the conditions, that if they were to keep pace with the ever-increasing demand for rails, they must increase the output of their mills, and hurry up the process of manufacture from one end to the other.

Now, as a matter of fact, the only earthly chance for the production of a good quality of rail by the Bessemer process, when the ores are of undesirable quality, lies in the *extension* of the time of manufacture, not in its *curtailment*, as we shall now proceed to show.

We have already explained that after the molten cast iron has been blown in the converter, the proper percentage of carbon is reintroduced by pouring some molten spiegeleisen into the blown metal. When the addition is made, it is desirable that some little time be given for the necessary reactions to take place; and in the early days of manufacture quite a definite period was allowed before the recarbonized metal was poured into the ingot mold. To-day, however, there is no delay whatever, the spiegeleisen being introduced into the converter at the very time that the latter is being tipped over to discharge its contents into the ladle; and from the ladles the metal is immediately poured into the molds.

Another, and by far the most serious, change which has been made in the endeavor to increase the output and reduce the time of manufacture relates to the cropping of the ingots. By referring to the accompanying illustration, showing a vertical section through an ingot after it has cooled, our readers will see that in the process of cooling two important actions take place. First, there occurs what is known as a segregation of the material; that is to say, certain of the constituents of the steel, such as the carbon, phosphorus, and other impurities, being of lighter specific gravity, tend to separate out from the mass and gather toward the top of the ingot. Also, since the metal cools from the outside toward the center, there is a tendency of the solidifying metal to shrink toward the outer surfaces, and this causes a cup-shaped depression at the top of the ingot, which extends down in the form of a narrow slit or crack into the body of the metal, which, together with gas bubbles, forms what are known as "pipes." Evidently, the upper portion of the ingot, because of this segregation and piping, is less pure, more brittle, and more subject after rolling to contain longitudinal flaws. Consequently, in former days, it was customary to crop off from the ingot from 25 to as high as 33 per cent, and roll the rail out of the remaining two-thirds, the rejected portions being remelted in the furnace.

But in the endeavor to increase the output of the mills and keep pace with the demand, manufacturers have reduced this cropping of the ingot to as low, in some cases, as from 8 to 10 per cent, removing merely the extreme end of the ingot. To take a typical case, an ingot measuring 19 inches by 19 inches by 48 inches long, if cropped 30 per cent would make three 80-pound rails; but with a cropping of only 7 or 8 per cent, the same ingot would produce four such rails.

Now the engineers claim that this extra rail is not reliable, both because of the segregated material which it contains, and because of the fact that as it is rolled down to shape it is liable to include the "pipe," or incipient longitudinal fracture which existed in the ingot itself. The manufacturers, on the other hand, claim that while they cannot produce quite so good a rail from the upper fourth of the ingot, they can still produce a sufficiently good rail for practical purposes. A rail which contains within itself the unclosed, unwelded opening, which was carried over in manufacture from the ingot, is known as a "piped" rail. The manufacturers claim that the breakages rarely occur from "pipes." The engineers contradict this, and say that the experience of last winter particularly shows that "pipes" were the most frequent cause of breakage. It would certainly seem from a study of the accompanying photographs, which were taken at random from hundreds of rails which lay alongside the tracks of one of our leading railroads, that "piping" is by no means an infrequent cause of rail breakages.

From the above considerations we believe our readers will agree that the situation is pretty clearly defined. Evidently, under existing conditions, with the low-phosphorus ores practically exhausted, the only thing left to be done, if we are to have absolutely reliable rails that will not break under the present heavy loads and under the conditions of frozen tracks, is to abandon the making of rails by the Bessemer process and get rid of the phosphorus and other impurities by adopting in its stead the Open-Hearth process; at once return to the slower methods of manufacture of a few years ago; be content to crop more freely from the head of the ingot; and also adopt, in the subsequent manipulation of the rails, a slower process with more frequent passes through the rolls and a more gradual bringing of the rail to its final shape.

THE PERIL OF THE "BROKEN RAIL"—ITS CAUSE AND CURE.

THE CONSTRUCTION AND HANDLING OF SUBMARINES.

(*Continued from page* 408.)

age batteries are stowed in tanks inside, at the bottom of the boat, and by a system of clutches the main shaft can be connected to either the motor or gasoline engine.

The "Lake" is a specimen of the even-keel type of submarine, which was launched at Newport News in February, 1906. She has a submerged displacement of 250 tons, is 85 feet long, and has been manufactured in this country and abroad for several years by the Lake Torpedo Boat Company. The term "even-keel" refers to its method of submergence, the vessel attaining submerged depths without changing its longitudinal stability or horizontal trim, as it is unnecessary to point the bow downward in order to submerge. The "Lake" is constructed with steel cigar-shaped hull, over which is built a wooden superstructure, which forms a level deck of a few inches freeboard while the vessel is on the surface. Within this superstructure, and outside of the steel hull, are stored the gasoline fuel tanks, air flasks, etc. Water is also admitted to the superstructure when the vessel submerges. The Lake boat has the same motive power as the Holland boat. The air system also is practically the same as in the Holland boat, but the air flasks are stowed on top of the main steel hull instead of inside. Submergence is attained first by admitting water ballast to tanks contained in the steel hull and superstructure to bring the craft awash, or with tip of sighting hood alone showing above the surface; and then hydroplanes, or horizontal steel wings at the sides of the vessel, are tilted in such manner as to cause the water to impinge against them

and drive the boat down to the desired depth. A large conning tower is on top of the hull, of the same structural strength as the latter, and through this projects the omniscope or periscope. All the mechanism for operating the boat is centered in the conning tower. A water-tight hatch is provided to seal the conning tower off from the hull of the craft. One of the principal features of the Lake boat, devised to insure greater safety of the crew during submergence, is that of a drop lead keel of 5 tons weight, which can be readily freed from the bottom of the boat in case of danger by pulling a lever, thus giving the craft sufficient buoyancy to return to the surface. It is claimed that the knowledge of the letting go of this keel, which will instantly give 5 tons of positive buoyancy, inspires a feeling of safety and tends to banish nervousness from the crew while the boat is submerged at great depths. Forward is also a diving compartment for leaving the vessel when submerged, working on the same principle as a diving bell. This compartment is not so much a safety compartment as it is for a diving bell for carrying on work at the bottom of harbor entrances, through which a diver may proceed to the water-bed and submarine mines can be destroyed and laid. The vessel has buffers or wheels, which keep the hull from injury when running on the bottom. The "Lake" has twin screws, which are driven by gasoline engines when traveling on the surface and by electric engines alone when submerged.

One of the up-to-date features recently installed on the "Plunger" is a copper signal buoy, 15 inches in diameter, which is arranged to be readily released from the inside in case of danger while the boat is submerged. This rises immediately to the surface, indicating the exact position of the craft, and serving as a distress signal in case of an accident. The ball buoy and a reel of 200 feet of 3/16-inch bronze wire are incased on the bridge, just in front of the conning tower in a box-like compartment. A telephone can be installed inside to afford direct communication to the submerged boat. Large ring holes also have been attached to the "Plunger" and the other submarines, so that they can be lifted and brought to the surface immediately in case of a disaster.

Of unusual and timely interest are the photos here reproduced, giving a realistic glimpse of one of these wonderful little engines of destruction of the diving type now in service. Both sides and every foot of the round steel tube are lined from stem to stern with intricate and delicate machinery, levers, valves, etc., each having a particular function in manipulating and operating the fish-like craft in the depths of the sea. The center view, looking aft, shows the commanding officer's platform above the conning tower and steering wheel. To the right is the large inside tiller wheel, and below, the wheel to operate the diving and horizontal rudders, while in the background is the compartment for the engines. On the left is shown the large indicator, registering the submarine's depth below the surface, and its deflection from the horizontal. Below this is one of the 2,000-pound air flasks, underneath which is one of the ballast tanks. The bow view shows the main fighting feature of the craft, viz., the torpedo tube, and the pipe above connected with the air flask for expelling the torpedo from the tube. On the right and left sides are seen the air flasks and ballast tanks. The important forward trimming tanks are shown on either side of the torpedo tube. The vessel is made to dive bow down by aid of each particular tank. Above the torpedo tube are a special steering wheel for pointing the submarine at the time of firing, depth registers, speed indicators, etc. For getting the range while submerged, a periscope is employed, the end of which protrudes a foot or more above the surface, which reflects below the location of surface objects. On firing a torpedo, the boat has to be pointed, put nearly level, and at the same time kept beneath the surface at the requisite depth, so as to have the periscope lens just clear of the water—all of which requires great care and intelligence on the part of the officers and crew.

The Current Supplement.

The new Connecticut Avenue Bridge at Washington, D. C., the largest of its kind in the world, is about to be opened. This is one of the most noteworthy concrete bridges in the world, for which reason engineers will doubtless read with interest Mr. F. N. Bauskett's article on the structure in the current SUPPLEMENT, No. 1637. Simon Lake writes on safe submarine vessels and the future of the art. Coming as they do from a well-known authority, his criticisms and his advice are valuable. A new method of treating sewage, invented by W. D. Scott-Moncrieff, is described and illustrated. M. Klar's splendid dissertation on the manufacture, denaturing, and the technical and chemical utilization of alcohol is concluded. In this particular installment he describes the malting process, the gelatinization of the raw material, the saccharification of the raw material, production of the yeast, fermenting the sweet mash, and the production of alcohol from the mash. Joel A. Allen continues his treatise on the influence of physical conditions in the origin of species. Our Berlin correspondent discusses electrically-operated equatorial mountings for telescopes, elucidating his remarks with many helpful photographs. "A Method of Photometry of High Candle Power Units" is a title of an iconoclastic article by F. B. Lambert. The two hundredth anniversary of the birth of Linnæus falls upon May 23, 1907, and for that reason the splendid biography prepared by Dr. H. Kramer should be read with interest. Dr. Alfred Gradenwitz describes a new direct-reading wind gage.

The Geological Survey's New Director.

With this issue, a new name appears at the head of the weekly press bulletins published by the United States Geological Survey. It is that of the new director, Dr. George Otis Smith, who was appointed by President Roosevelt to succeed Mr. Charles D. Walcott on the retirement of Mr. Walcott from the directorship to take up his new duties as secretary of the Smithsonian Institution.

Dr. Smith is one of the younger members of the Survey in point of age, as it is only thirty-six years since he was born at Hodgdon, Aroostook County, Maine. He has, however, had fourteen years of continuous service in geologic work. After graduating from Colby College in 1893, he joined a Geological Survey party working on the Marquette iron range, Michigan. During the three following years he took a post-graduate course in geology at Johns Hopkins University, receiving in June, 1896, the degree of Ph.D. As the result of a civil service examination which he took for the position of assistant geologist, he became connected with the United States Geological Survey soon after his graduation.

As assistant geologist and as geologist, Dr. Smith has worked in Michigan, Washington, Utah, North Carolina, the New England States, New Jersey, and Pennsylvania. For seven field seasons he was engaged in reconnaissance and detailed surveys in Washington. In the course of this work he made a special study of several artesian basins, and the results were published in a water-supply paper. He made a report also on the coal fields of the Pacific coast. The results of his investigations in Washington found further expression in a report on the rocks of Mount Rainier, in the Tacoma, Ellensburg, Snoqualmie, and Mount Stuart folios, in a professional paper on the geology and physiography of central Washington, and in a paper on gold mining in central Washington. In addition Dr. Smith contributed articles to the bulletins of the Geological Society of America, and to various periodicals.

In 1900 the United States Geological Survey issued the Tintic Special folio in which Dr. Smith described the geologic structure of that famous Utah camp. He had previously co-operated with Mr. G. W. Tower, Jr., in producing a report on the geology and mining industry of that district.

Following his years of activity in the far West, Dr. Smith began areal work in Maine. Eventually, supervision of all the Survey's geologic work in New England was assigned to him, and direction also of the geologic work in the areas of crystalline rocks in New Jersey, Pennsylvania, and Maryland. In the course of these investigations he made a special study of several economic subjects. The Survey's statistical reports for 1905 on mica, graphite, and asbestos were prepared by him. Last July he was appointed geologist in charge of petrology with scientific supervision of the Survey work in that department.

Recently Dr. Smith has had special opportunities of studying the methods and organization of the Survey and of other government bureaus. He served as chairman of the committee on accounting and bookkeeping, which has been working for the past year under the direction of the committee on departmental methods appointed by the President and known as the Keep Commission.

Dr. Smith is a fellow of the Geological Society of America, a member of the American Association for the Advancement of Science, of the American Institute of Mining Engineers, of the American Forestry Association, and other scientific societies.

A gasoline tank rarely explodes. It cannot unless it contains gasoline vapor and air in explosive proportions, which latter condition is almost never present. It does not explode because it contains too little air or too much gasoline. Even if a tank of gasoline were to burst from heat applied to its exterior, the confined heavy gas would not explode if in contact with flame or fire, but would burn instead. True, a tank of gasoline with no vent could do considerable damage were it to burst and throw burning oil and flaming gas about, but one thousand gallons of gasoline in a vessel's bilges would not be so dangerous from explosion as a hundredth of that amount. The larger quantity would burn rapidly, while the smaller would be sufficient, if mixed with the proper amount of air, to utterly demolish almost any boat.

Correspondence.

Cyclone Observations.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in issue of March 16 article by W. T. Hall in regard to center of funnel of cyclone being white. Some years ago I saw a phenomenon similar to that on a small scale when I visited the great Karg gas well at Findlay, Ohio. The flow of gas from a pipe 5 inches in diameter, and at a pressure of (I think) 175 pounds to the inch, was ignited and allowed to issue from the pipe horizontally about three feet above the water of the river. The force of the gas projected the flame from 50 to 100 feet horizontally, and the heat and currents caused the steam rising from the water to take form of miniature cyclones, and one after another they formed and slowly moved over the water in a course parallel to the flame, and each one, shaped like a slender vase, semi-transparent, showed a whitish core or center its entire length. It was in the dusk of evening, and in the strong light these twisters showed with remarkable distinctness, and one after another they rose upward and disappeared. I thought at the time that conditions must be similar to cause the great destructive cyclones.

In the same paper, relating to the experiment in acoustics where the boy ringing a bell ran to meet others, and the effect of the sound on those meeting him: I have frequently noticed the same effect when riding on the cars and meeting another locomotive on which the bell was ringing. As our car approached the strokes of the bell would be abnormally loud, and soon as we passed the sound of the bell was scarcely heard at all. I have wondered what the reason was and never heard it explained. F. M. PRIEST.

Klamath Falls, Ore.

The Prevention of Sea-Sickness.

To the Editor of the SCIENTIFIC AMERICAN:

Through the kindness of the American consul-general here, my attention is called to No. 293 of the Export Edition of the SCIENTIFIC AMERICAN, January, 1907. On page 15 of this number you publish "A New Remedy for Sea-Sickness."

Allow me, in the interest of ocean travelers in general, to state the following:

For the last fifteen years I have studied the question of a costless prevention of sea-sickness.

A remedy for curing sea-sickness there is none, and will never be. The point therefore lies in its prevention, for "prevention is better than cure." My simple head-bandage made by folding a towel, a large handkerchief or anything similar, dipped into hot salt or sweet water, and applied round the head a few times, restores the proper circulation of the blood, relieves the abdomen from pressure, and checks the cerebral anæmia.

The question I wanted to solve was to find a costless way of preventing sea-sickness. While traveling over thirty years in all kinds of weather, at all seasons, on the seas of this globe, I always felt a great pity for the steerage passengers, especially women and children, who had to suffer so severely when the sea got rough. For this reason I had to abstract from the application of any apparatus, be it electrical appliance, thermophore, or any other construction for which a man has to pay.

The system of hot-water bandages round the head (as one can hardly call it an invention) is mine; all inventions and constructions that have come out ever since I published my simple prescription are based on my system and have passed through my hands; up to now every one of them I have had to condemn for being too heavy, cumbrous, dangerous, or too costly, etc.

If any of them were useful the large steamer companies would have accepted them at once. You can well imagine how very important it is for steamer companies to prevent people becoming sea-sick in the cabins. How pure and sweet the air would be at sea in the cabins if it were not for the repeated vomiting of bile, whose effluvia are extremely volatile and settle down at once in the curtains, floor, ceiling, paint, sofa, beds, etc., of the cabins. This in time forms one of the principal items denominated by travelers, when they enter a cabin, as "ship's smell."

Perhaps you will in the interest of humanity publish this letter (you will plainly see that I have no monetary interest in the matter), and also publish my prescription for the prevention of sea-sickness, which ought to be copied by your newspapers. In winding up allow me to say that hundreds of people whom I have never seen in my life have written to me to express their thanks for my prescription.

EUGENE WOLF, Explorer.

Munich, Bavaria.

[The prescription referred to in the above letter instructs the patient to lie down flat on the back, and fold a towel soaked in water, as hot as can be endured and as tightly as possible around the head, reheating the towel at intervals.]

CONSTRUCTION OF FLORIDA EAST COAST RAILWAY.

BY ALLEN HALE.

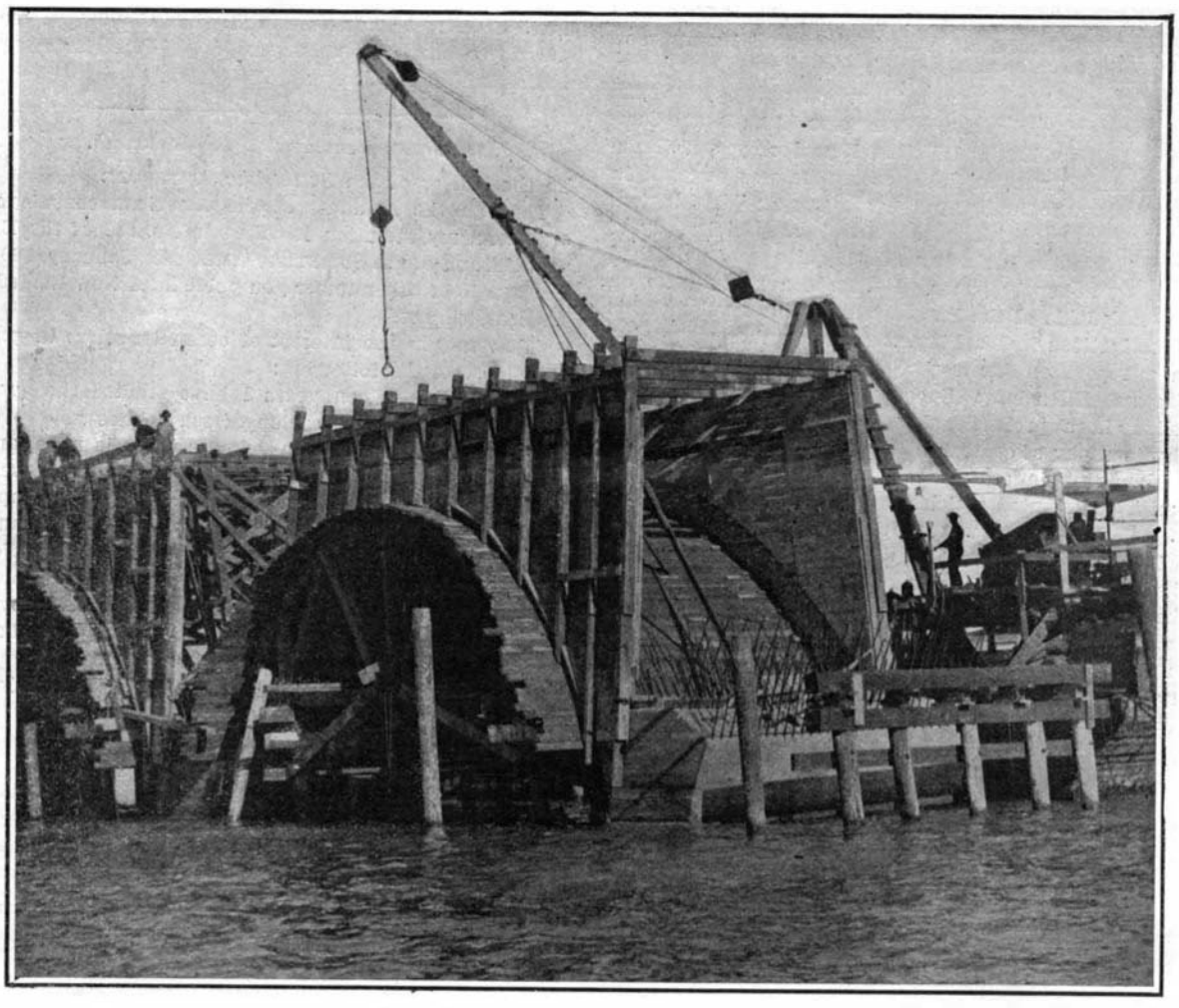
The extension of the Florida East Coast Railroad to the city of Key West, Fla., which was partially described in the SCIENTIFIC AMERICAN in 1905, has progressed to such a point that an idea can now be gained of the really remarkable engineering feats which are being carried out in the construction of what is really a railroad over the sea. This is not a figurative term by any means, for of the 156 miles of track which must be completed between Miami on the mainland and Key West, fully 75 miles will lie over the water, and a considerable portion over the sea itself.

The Florida keys may be called a series of stepping stones leading into the ocean. They extend between the Florida peninsula and Key West in the form of a curve, the channels separating the islands varying from a few hundred feet to several miles in width. Between the nearest key and the mainland is a stretch of salt water marsh, which must be spanned by trestling and other structures, as the formation will not admit the building of a solid roadbed. The first 29 miles of line south of Miami are along the mainland, where construction work is comparatively easy. The next 19 miles, however, are through a heavy mangrove swamp, with insufficient water to float dredges and not enough material within reach for wheelbarrow work; a condition which made it necessary to dig channels to accommodate the dredges used in building this section of the embankment. At Land's End, where the swamp begins, two dredges were first constructed, and an excavation made wide enough to contain a dredge, with a depth of 2½ feet of water. Then these two dredges made their way down the two sides of the embankment, digging their own channels and using the material excavated for rearing the railroad embankment, but hampered and delayed at many points by the rock, which came so near the surface as to necessitate the construction of locks to float the dredges over them. Two additional pairs of dredges, making six in all, have been employed in this particular work, two of them starting at the southern end of the section and working north, while the other two worked up through Black Water Bay to Barnes Sound to about the middle point of this construction.

Nearly thirty islands are to be used for short stretches of the construction, the longest being 16 miles, on Key Largo. More than 50 miles of rock and earth embankment will be built where the intervening water is shallow; but where the water is deeper and the openings are exposed to storms by breaks in the outer reef, concrete-arch viaduct construction will be used, consisting of 50-foot reinforced concrete, circular-arch spans and piers, with occasional spans of 60 feet. This will be the most difficult part of the work. The water is from 10 to 30 feet deep in most places, and the bottom is limestone. There are four of these arch viaducts, aggregating 5.78 miles in length. They extend from Long Key to Conch Key, 10,500 feet; across Knight's Key channel, 7,300 feet; across Moser Key channel, 7,800 feet; and across Bahia Honda channel, 4,950 feet. The material of these islands is coraline limestone. In many places the embankment is 8 or 9 feet in height, which when the roadbed is ballasted with the same material, affords foundation for one of the finest and safest tracks in the world.

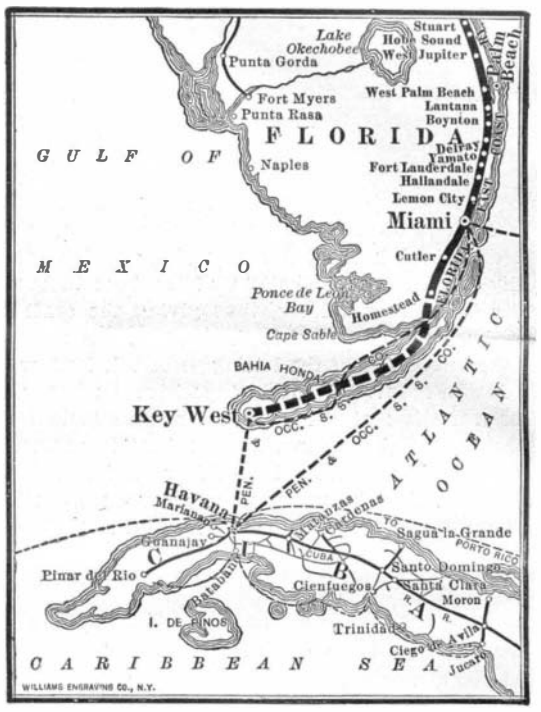
South of Bahia Honda the work is being done largely by land dredges or excavators. Three or four large land forces are assembled in this territory. At the present time there are ten excavators employed in the work, each excavator being expected to do the work of 50 or 100 men daily. In getting in on the line of actual work, many of these excavators had to dig their own way, and were from one to four months in reaching their respective stations.

The route over which the line is to be constructed consequently offers a variety of problems for the engineers to solve. As already stated, the great extent of marsh requires not only very large fills, but extensive trestling, and much of this work is almost as difficult and expensive as the viaducts which must be built between the keys. As is indicated, however, the engineers have taken advantage of powerful suction dredges, and in this way have accomplished results which would have been impossible to attain without the aid of such machinery. While the roadbed has been thrown up by means of these dredges through a portion of the Everglades, they have also been employed for filling on some of the low marshy islands. At some points a wooden framework has been made along the right of way. Through this has been extended pipe from the dredges, and this immense trough filled with the detritus consisting of sand, mud, and gravel taken by the dredge from the shore of the key or some other convenient point. The wooden framework holds the material in place roughly, forming the roadbed, which is surfaced with coral rock where possible.



CONSTRUCTING THE CONCRETE VIADUCT THAT WILL SPAN THE OCEAN BETWEEN LONG AND GRASSEY KEYS.

Length, 10,156 feet. The viaduct will contain 186 arches of 50 feet span. Every fifth arch will have 60 feet span. Height 31 feet above high tide. This picture shows the arch and spandrel wall forms in place ready to receive the concrete.



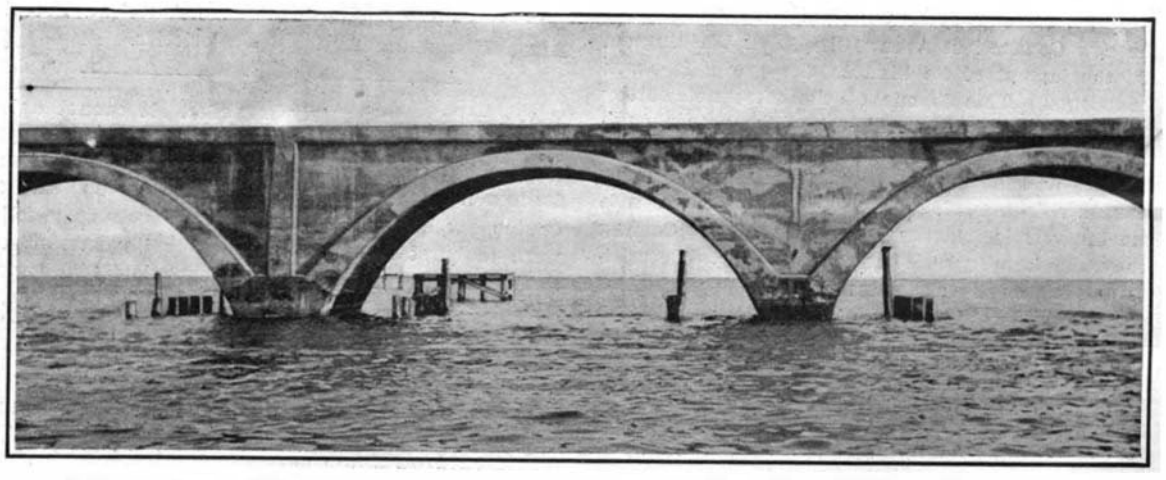
MAP OF FLORIDA EAST COAST RAILWAY.

From Jacksonville to Miami is 366 miles; from Homestead to Key West, 128 miles.

It may be needless to say that the building of the concrete viaducts has been one of the most interesting phases of the entire project, not only because of the size of the larger ones, but by reason of their location. It can be said that they are being constructed literally upon the open sea. In many places, where the water is deep enough to float a large-sized ocean steamship, and where the locality is exposed directly to the gales of the Atlantic, much of the work thus far completed has been performed by floating plants, where the concrete is mixed and placed in position by means of powerful boom derricks. In the shallower waters, molds for the foundation of the viaduct have been formed by driving piling which supported watertight framework. The water was then pumped out, and the molds filled with concrete in the usual manner. In many places, however, the depth of the water has prevented this mode of operation, and it has been necessary to sink caissons or to construct coffer dams in which to place the material. As the photographs show, the concrete utilized is reinforced with metal rods, which extend from top to bottom of the mass, thus strengthening it considerably. The concrete arches are of course formed in molds of timber, but these are constructed on the mainland and towed into position by means of steamers. It may also be added that all the material, including the broken stone for the concrete, must be shipped by boat from Miami, near which town it is quarried. This is true of all fuel, supplies, and water for the men upon the work. In many places, in order to get supplies to the excavators, the supply boats have to travel eight or nine miles out of their way to reach a point not over a mile distant in a straight line.

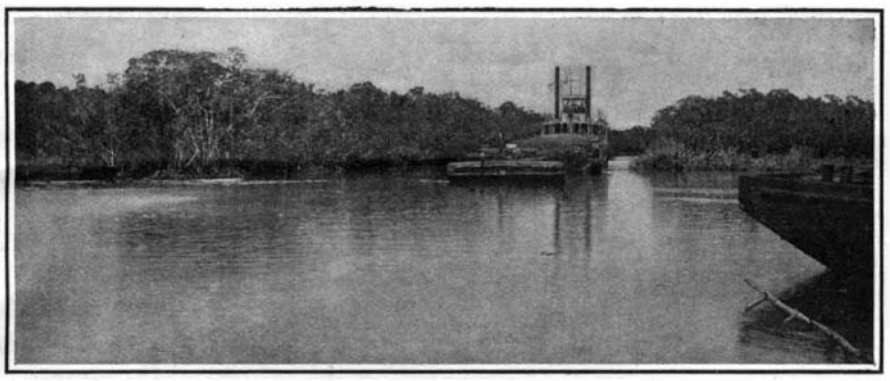
Every drop of water used by the men and machinery has been, and must still painfully be, transported in tanks more than 100 miles. At one time it was thought to cut this distance down by hauling water from Manatee Creek, 50 miles distant. Accordingly a water station was put in, and an attempt made to haul water from that point. Along came a northwest wind one day and blew the water out of the bay, so that it was impossible for boats to get within two miles of the water station, and it was necessary to go back to Miami until the water regained its natural level. Three weeks later the wind came from the southeast, and piled the water up in the bay in such quantities as to drive them out again.

Engaged in the work have been 9 sternwheel boats, 3 tugs, over 100 lighters or barges, ranging from 100 feet in length to 120 feet and from 25 to 30 feet in



THE CONCRETE VIADUCT AT THE LONG KEY END. THESE CONCRETE BRIDGES ARE CONSTRUCTED LITERALLY OVER THE SEA.

width, 28 launches of various sizes, 6 or 8 pile drivers, 4 or 5 concrete mixing plants costing $16,000 to $17,000 each, 10 excavators, 3 derrick pump barges, 13 dredges, each varying in capacity from 10,000 to 200,000 cubic yards per month, machine shops, ways, locomotives, and a quantity of minor machinery and equipment, which altogether has cost the company more than $450,000.



AMONG THE FLORIDA KEYS. JEWFISH CREEK DREDGE ENGAGED IN EXCAVATING.

A ROCK FILL ALONG THE ROAD AT KEY LARGO. MORE THAN FIFTY MILES OF SUCH EMBANKMENTS MUST BE BUILT.

While this remarkable railroad on the sea will be one of the most expensive projects of its kind ever completed, it will result in the development of Key West into one of the chief seaports of the United States. The plans of the railroad company provide for the formation of a harbor which will contain no less than 170 acres. It will include the building of extensive docks and terminals, from which an ocean-going ferry will transport cars directly to Havana.

The work is carried on entirely by the Florida East Coast Company itself, under the immediate direction of the vice-president, Mr. J. R. Parrott, who is its directing force, and Mr. J. C. Meredith, the constructing engineer. No contractors are employed. Under the constructing engineer are the assistant and second assistant engineers, a general foreman in charge of all the work under the chief assistant and superintendent of dredges, a master mechanic, foreman of carpenters, chief of drafting department, chief office assistant, auditor, superintendent of commissary, chief storekeepers, paymasters, superintendent of marine department, engineer of marine department, and engineers and foremen in charge of each specific piece of work. At present about 3,000 men are engaged in the work, but as many as 4,000 have been employed at one time.

THE MATERIAL OF THE KEYS IS CORALINE LIMESTONE, WHICH MAKES AN EXCELLENT BALLAST.

In this picture, the men are shown getting out the rock for the embankment at the left.

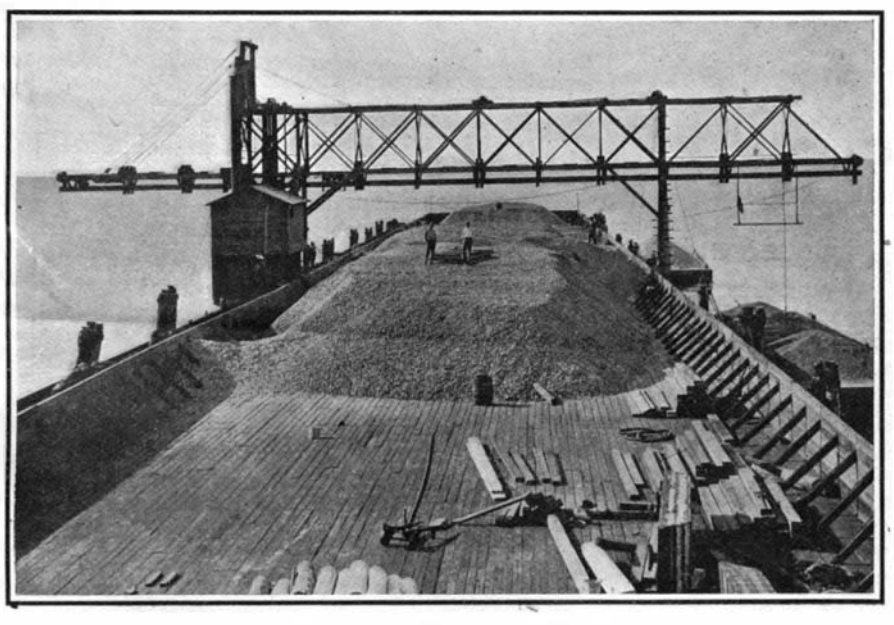
RANK VEGETATION GROWS ALONG THE RIGHT OF WAY.

Not a little difficulty is experienced in clearing a path.

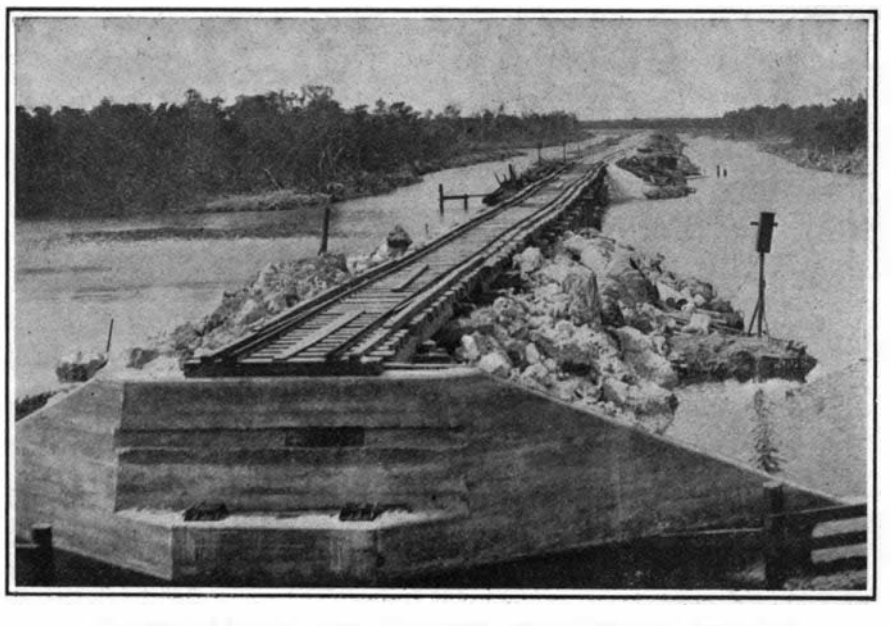
The present plans include the construction at Key West of one large drydock and ten wharves, each 800 feet long and 100 feet wide, with basins 200 feet wide between, in which the depth of the water will be from 20 to 40 feet. The piers will afford berths for forty vessels averaging 400 feet long. As the distance from Key West to Havana is but 90 miles, the transportation of freight and passenger cars by means of powerful steam ferries is entirely practicable, and it is expected that the trip can be made in about four hours across the Gulf of Mexico.

While a considerable mileage of track has already been laid upon the keys as well as the extension through the Everglades, the concrete viaduct will probably not be entirely completed before 1908. It is calculated to have the extension in operation, however, by transferring passengers and freight across the wider channels between the keys, so that travelers may be utilizing this route to Key West and Havana within the next year.

Among the new automobiles for army use which have appeared on the Continent we may mention the new heavy hauling car lately built in France for the Minister of War by the Mors Company of Paris. It is a long platform car with an unusual wheel-spread, having an open driver's cabin placed just back of the radiator. The motor is of the upright 4-cylinder type, and is rated at 24 horse-power. Chain gear is used upon the rear wheels. The hauling car can take a net load of 8,000 pounds or more. It is designed to be used for the rapid supply of fortresses, and in case of mobilization it will be of great value, especially in transportation of water, as it can carry four great metallic casks which will replace the usual tanks, as the latter are difficult to handle. The Lorraine-Dietrich Company, of Paris, have also brought out a new car for the army. This is a touring car, and is remarkable for the fact that it has six wheels. A much greater length can be given to the car. It has four seats of two places each, and besides the efficiency of the system is much greater, both as regards the relation of motor and weight as well as the question of keeping in order and personnel for a given load. It runs more smoothly than an ordinary car, and this allows a solid rubber tire to be used. A regiment of military chauffeurs has been organized in the Austrian army, following the example of Germany. The men wear a special uniform. The new regiment will take part in the annual army exercises which are soon to be held in Austria.



THE WHARF AT KNIGHT'S KEY.



VERY LARGE FILLS AND EXTENSIVE TRESTLING ARE REQUIRED.

ENGLISH EXPOSITION OF MODEL FLYING MACHINES.

The Aero Club of Great Britain and the London "Daily Mail" deserve great credit for the encouragement recently given inventors of heavier-than-air machines by the exhibition of such apparatus in Agricultural Hall, London, and by the subsequent trials, both in the Alexandra Palace and in the open air, of such models as were capable of flying. Three cash prizes of $750, $375, and $125 were offered by the "Mail" for the three model aeroplanes which made the longest flights and showed the best stability. Altogether, no less than 128 model aeroplanes and other heavier-than-air machines were exhibited. The inventors of these machines ranged from such experienced men as Major Baden-Powell to a poor old farmer, John Hall, who walked 94 miles to London to exhibit his machine. The striking thing about most of the models was the workmanship and thorough finish put upon them. A number were designed and built by men of marked mechanical ability, but nearly all were noteworthy for the skill and thoroughness spent in their construction. The several models which we illustrate are among the most interesting and typical that were on exhibition.

The Cochrane flier is an aluminium creation consisting of a corrugated cylinder rounded at each end and having peculiar round-blade propellers mounted at each end also. Twisted rubber bands extending through the cylinder revolve the propellers. Two curved wings, connected by a central curved surface, are riveted to the cylinder. Four horizontal fins, two on each side of the cylinder at the front and rear ends respectively, serve as horizontal rudders. By setting the rear fins at the proper angle, the machine is controlled in a horizontal plane. At first glance one would hardly expect this queer-looking model to fly, yet that it actually did so for a short distance is attested by one of the photographs. Mr. Cochrane also displayed a still more peculiar model of the flapping-wing type, which consisted of birds' wings attached to a pointed aluminium body having a fan-shaped tail.

Another aeroplane that flew a short distance only, but which we illustrate on account of its novel propelling power, is the skyrocket-driven machine shown above. This flier, as can be seen, consists of three wings or sails placed one behind the other in the same plane. It soon fell to the ground after being started on its flight. The photograph shows it at the moment of starting.

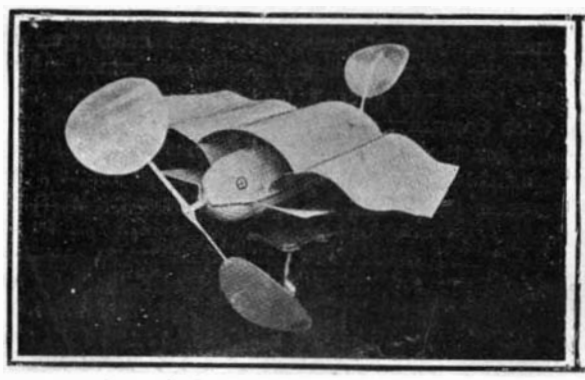
Although the aeroplane exhibition was a great success, the tests of the working models was, in the main, a fizzle. Of the dozen or more tried, but two—the "Avroplane," of A. V. Roe, and Mr. W. A. Howard's machine—were able to glide along in the air for any distance after the power was exhausted. The former was a machine of the type used by the Wright brothers. It consisted of two rectangular superposed surfaces used in connection with a third following surface of the same size placed in the same horizontal plane with the upper surface. A horizontal rudder was located in front. A long triangular framework underneath contained the stretched and twisted elastic bands used to drive a propeller at the rear. One of our illustrations shows a somewhat similar machine designed by the same inventor. Mr. Roe also displayed an excellent model of a single-surface, following-plane machine of the Langley type. His Wright-type glider made a flight of 90 feet indoors, but did not do nearly so well outside. It was awarded the second prize, the first prize being withheld.

A simple aeroplane designed by W. A. Howard and consisting of two sets of slightly-inclined planes placed at a dihedral angle and driven by a single propeller, made a flight of 108 feet. This flier was awarded the third prize.

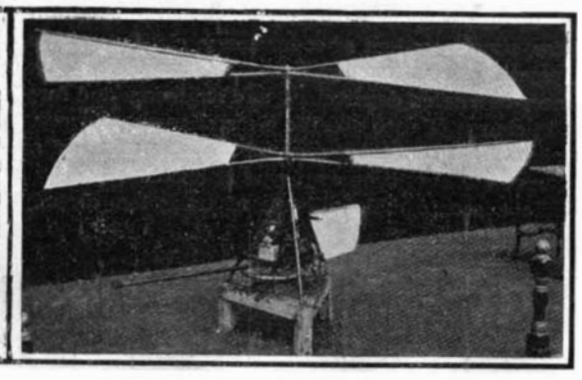
The bird-like glider shown in another of our illustrations is called the "Albatross." It was designed and constructed by Mr. Jose Weiss, a landscape gardener, who, after experimenting to a considerable extent with model gliders of this kind, is now about to build a motor-driven aeroplane along the same lines. If properly weighted at the forward end of the body, one of these gliders will perform a flight, when started from a hilltop, of as much as half a mile. By mounting the "Albatross" on a small carriage and towing it at high speed, it can be made to soar in truly bird-like fashion. The models are formed as closely as possible after the bird whose name they bear, and when soaring they look greatly like a bird, and seem to have great stability.

The helicopter, or lifting-screw, type of flying machine was represented by a single well-constructed model. This model was complete in every respect, even to the man in the basket. A small electric motor was geared to drive the propellers in opposite directions. By sliding a weight along on a projecting horizontal rod, the machine was supposed to tip and thus receive from the screws a movement of translation in addition to sustentation. A rudder was also provided for steering. The model was unable to lift itself, owing to the motor being insufficiently powerful. This machine is particularly interesting just now because of the fact that Prof. R. W. Wood, of Johns Hopkins University at Baltimore, Md., is about to construct a helicopter upon the same lines. Prof. Wood has found it possible to lift about 35 pounds to the horse-power with this type of flier, and he is constructing one with 40-foot propellers and with a 40-horse-power Stanley steam engine for power.

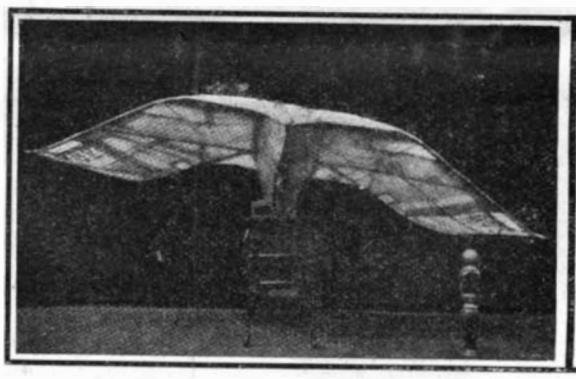
A Model Aeroplane Propelled by a Skyrocket.



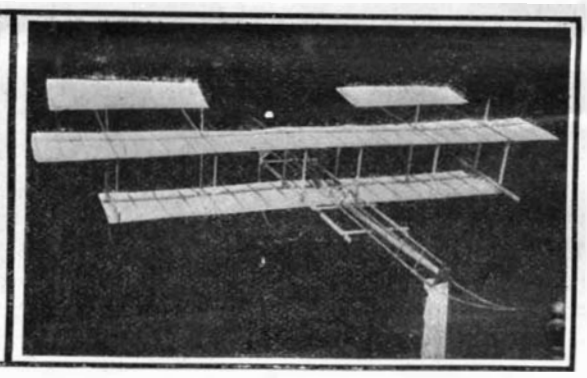
Cochrane's Aluminium Flier.



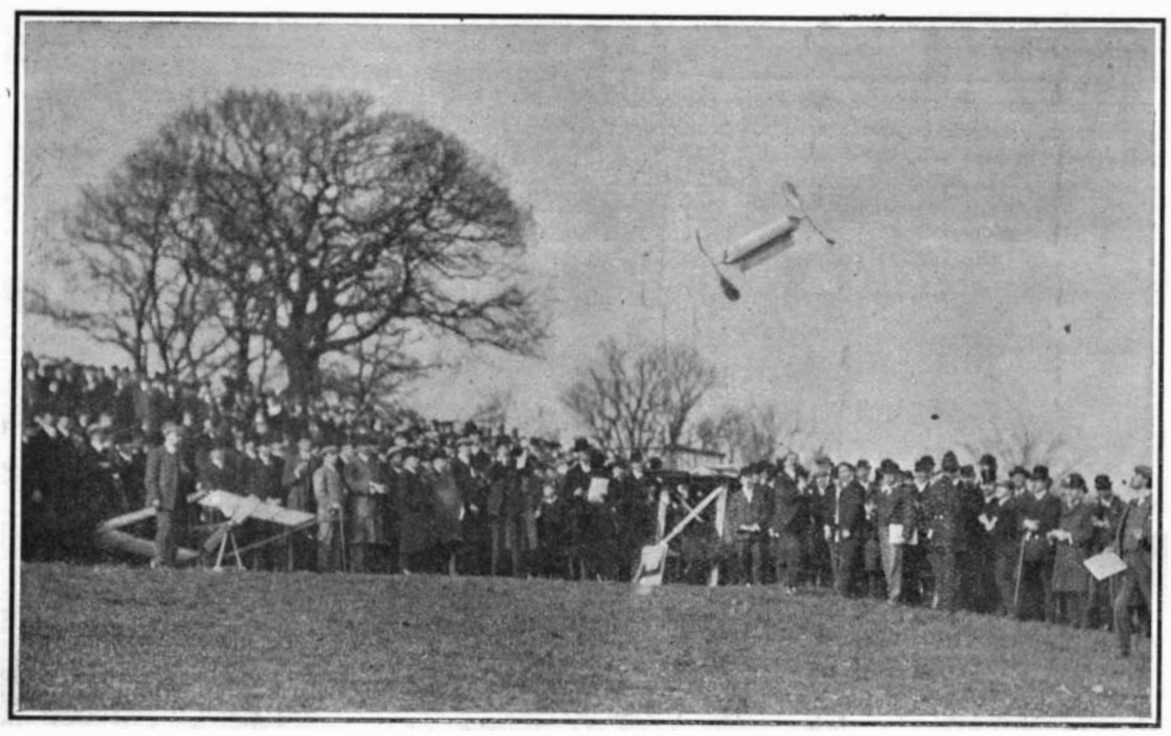
Chubb's Helicopter Model.



Weiss's Soaring-Bird Model.



One of A. V. Roe's Double-Deck Fliers.



Cochrane's Aluminium Model Making a Flight.

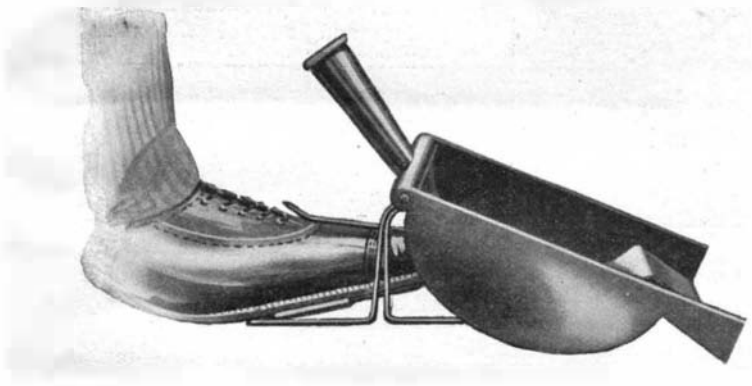
SOME ENGLISH FLYING MACHINE MODELS.

Heavy oil motors of the Diesel pattern are now used extensively in Germany, and we may cite among others the electric plant of the town of Aichach, which contains two 90-horse-power motors of this type. These motors are of the single-cylinder variety, and run at 160 revolutions per minute. For a load of 75.7 horse-power, they consume 0.213 kgs. (0.469 lb.) of oil per horse-power-hour. The combustible used is a paraffine oil which comes from Halle and it has a good calorific power. On the tests it was shown that the variations of speed due to throwing on the load or removing it did not exceed one per cent for a variation of 45 per cent of the full load. Flywheels weighing 9.5 tons and measuring about ten feet in diameter are used. Water for cooling the motor is used at the rate of 3 gallons per horse-power-hour, with a difference of 60 deg. C. between the inlet and outlet. The two motors in the Aichach plant are belted each to a dynamo of 62 kilo watts running at 600 revolutions per minute.

Patent Department

DUSTPAN WITH FOOT ATTACHMENT.

In the search for opportunities to exercise their ingenuity, inventors are only too apt to overlook the little details close at home, and hence it happens that the household, the oldest of institutions, is still sadly in need of many improvements. The accompanying engraving shows that there are possibilities for invention even in a dustpan. It seems odd that no one

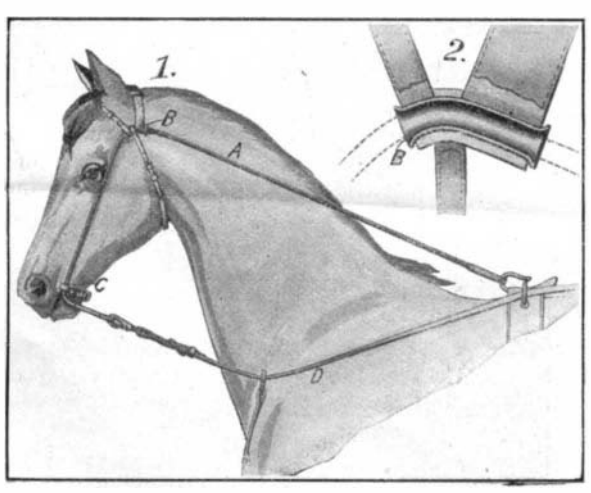


DUSTPAN WITH FOOT ATTACHMENT.

before has thought of the incongruity of using a short-handled dustpan with a long-handled broom. Mr. C. W. Robinson, of 923 Fourth Street, San Diego, Cal., has devised the pan which we here show with a view to obviating the necessity of stooping over when sweeping dust into the pan. The improved pan is formed with means for attaching it to the foot of the operator, so that it can be conveniently held at the proper working angle while both hands are used in wielding the broom. The foot attachment is formed of wire, bent to such a form as to provide a support for the pan and also a stirrup for the foot. The stirrup is in the form of a spring clip, so that it will cling to the foot of the operator as it is moved from place to place. When disengaged from the foot the pan will stand at the proper working angle, being supported by the wire frame. The invention also provides an improvement in the pan itself. Instead of having a flat bottom, the pan is formed with a pocket in which the dirt may be received. This will prevent the dirt from sliding out of the pan when it is moved about.

AN IMPROVED BRIDLE.

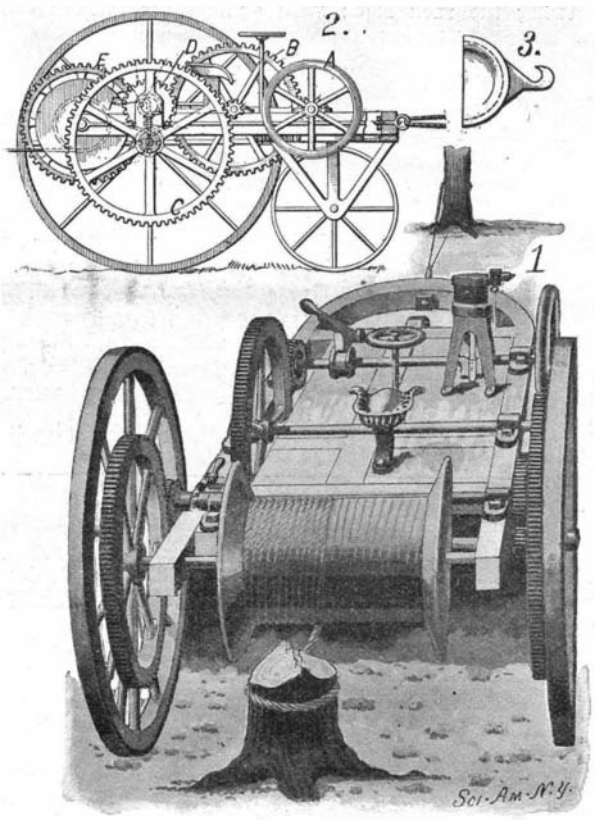
The accompanying engraving illustrates an improved form of bridle which is of very simple construction and provides an effective means for bringing a horse to a quick stop. The bridle is humane in its action and is so arranged as to multiply the power at the bit as compared with that applied to the reins. It thus enables the driver to control the horse with small exertion. The check rein which is shown at *A* passes through an elbow, *B*, which is supported by the head and brow straps. Thence the check rein passes down through eyes formed on the ends of the bit and is buckled to the reins, *D*. The bit is concavo-convex in cross section with rounded edges so as not to injure the tongue or the mouth of the horse. It is preferably made of aluminium with a steel core and is arched over at its center to fit the lower jaw of the horse below the grinders and above the nippers in such a way as not to interfere with, or press on the animal's lips. In operation, when the reins are pulled, the bit is pressed on the horse's tongue, allowing the check rein to slide freely through the elbows, *B*, and eyes of the bit, *C*, thus drawing the horse's head upward with multiple force. It will be evident that by this arrangement with a slight pull on the reins the horse's head is forced to stand erect through the action of the check rein, and the check rein at the same time performs its ordinary function. The inventor of this improved bridle is Mr. Robert H. Williams, of Maize, Kan. (P. O. Box 28).



AN IMPROVED BRIDLE.

MOTOR-DRIVEN STUMP PULLER.

A recent invention covers an improved form of stump-puller provided with a motor, which may be used both for moving the machine from place to place, and also to furnish power for pulling stumps. As shown in the accompanying engraving, the machine consists of a platform supported on two traction wheels and a front steering wheel. The motor which drives the mechanism is mounted at the front of the platform, and drives a transverse power shaft on which the flywheel *A* is secured. The power shaft carries a pinion which meshes with a gear *B*. The latter is mounted on a shaft which carries a pinion meshing with a gear *C*. The gear *C* is mounted to turn freely on the rear axle of the machine. Securely fastened to this gear at the center is a pinion which meshes with a gear *D*, and the latter transmits the power of the motor through a pinion to a gear *E*. The gear *E* is keyed to a shaft which carries the winding drum of the machine. In operation, when it is desired to pull a stump, the machine is anchored by means of a cable, which is passed through an eyebolt in the front of the platform. The cable, which passes around the winding drum, is then attached to the stump to be pulled. One of the detailed views shows a form of fastening block which will be found useful for attaching the cable to the stump. It will be evident that when the motor is started, the winding drum will be turned with considerable power, owing to the step-down transmission gearing. In the side view of the stump puller it will be observed that the wheel in the foreground is broken away, leaving only a section

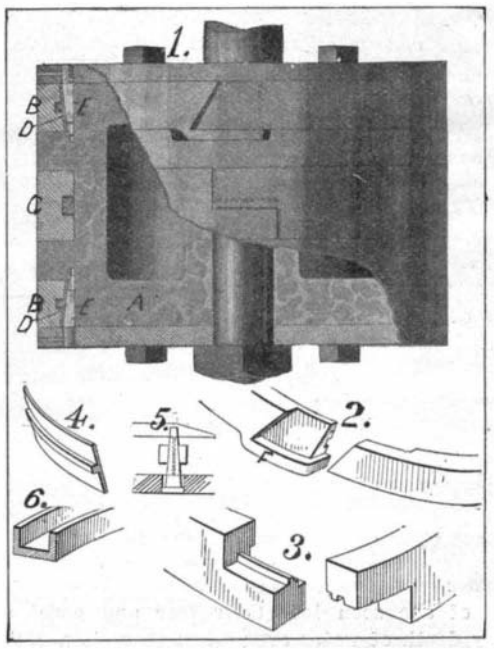


MOTOR-DRIVEN STUMP PULLER.

of the hub. It will be noted that the hub is formed with radial sockets, and that on the gear *C* a pin *F* is mounted to slide vertically. When it is desired to move the machine from one place to another, this pin *F* will be moved into engagement with one of the sockets, to couple the gear *C* with the hub of the wheel, so that the motor will operate to drive the traction wheels. The inventor of this improved stump puller is Mr. J. L. Jones, Rift, Ga.

METALLIC PISTON PACKING.

Illustrated herewith is an improved metallic piston packing for steam engines which is designed to impose very little resistance to the free movement of the piston, and at the same time remain tight in spite of considerable wear. The main body of the piston consists of a casting *A* formed with a pair of annular ribs. A disk is secured to each end of the casting and between these and the ribs a pair of recesses are formed in which the packing rings *B* are seated, and in the central recess between the ribs a bull ring *C* is seated. This bull ring is made in three sections connected together by step joints, the step projections being mortised together as shown in Figure 3 to assist in keeping the sections in proper relation to each other. The bull ring is formed with a groove on the inner side to receive a ring of spring metal which presses the sections into engagement with the cylinder. The main packing rings *B* are each formed in a single piece joined as shown in Figure 2. It will be observed that one end is provided with an extension *F* which passes under the other end and that the rib on the casting is cut away to receive this extension. Within each packing ring a spring ring *D* is fitted, this ring being formed with a tongue, as shown

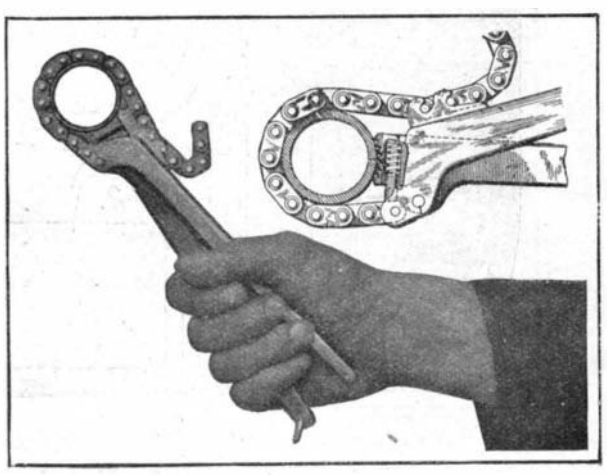


METALLIC PISTON PACKING.

in Figure 4, which is adapted to engage a groove in the packing ring. To adjust the tension of these rings a series of wedges *E* are fitted between them and the body of the piston. Each wedge is formed with a shank which enters an opening in the adjacent disk, and a pin seated in this disk engages a slot formed in the shank, the purpose of the pin being to limit the extent to which the wedge may be driven in behind the ring *D*. In Figure 6 an alternative form of ring is shown which may be used in place of ring *D*. Figure 5 shows an alternative method of spreading the ring *D*. In this construction the ends of the ring are formed with lugs between which the wedge *E* is driven to spread the ends apart. In the operation of the piston the bull ring serves as a packing and also as a guide for the piston in its movement, so that the wear is evenly distributed. The patent on this improved packing is controlled by P. H. Geoghegan, 35 Frankfort Street, New York.

IMPROVED PIPE WRENCH.

A recent invention, which we illustrate herewith, provides an improved pipe wrench of the chain type, in which a pipe of any diameter may be gripped, without any special adjustment of the chain, other than to hook it at the desired point. The wrench comprises two members, one of which is channel shaped in cross section, while the other is a bar of steel of such thickness as to fit into the channel. The two members are hinged together, and to the channel member near the hinge pin the chain is attached. The pivot pins, that connect the links of the chain, project beyond the links at each side. The channel member carries a pair of hooks, which are adapted to engage these projecting pins. The inner end of the bar member is formed with teeth adapted to engage the pipe. In use the two members are swung apart, so as to withdraw the toothed portion into the channel member. The chain is then passed around the pipe and hooked to one of the two hooks, after which the members are drawn together, forcing the toothed portion tightly against the pipe. A jacket is provided, which may be secured to the bar over the toothed end, thus adapting the tool for use on nickel-plated or polished pipes, which might be marred by the serrated surface. A spring-pressed plunger in the bar bears against the pivot of the first link of the chain, so that when the wrench is released the members will be spread apart. A ring on the bar may be slipped over the end of the

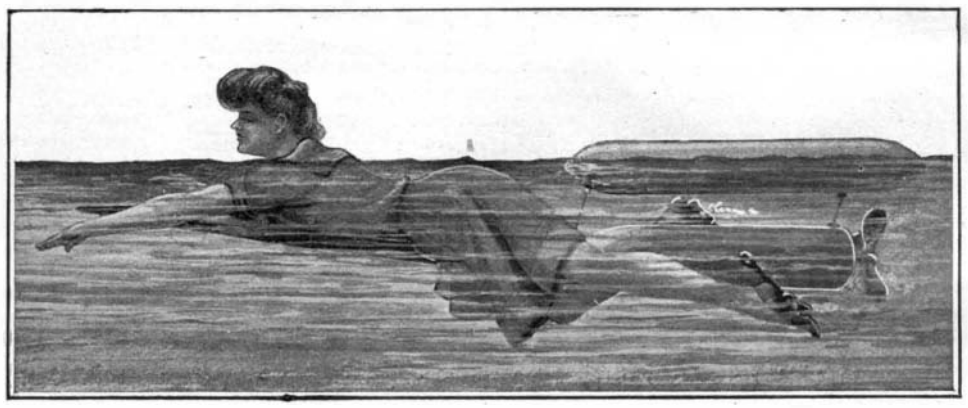


IMPROVED PIPE WRENCH.

channel member, to lock the two members together. Mr. M. Z. Viau, of 24 Durand Street, Plattsburg, N. Y., has obtained a patent on this improved pipe wrench.

A NOVEL SWIMMING APPARATUS.

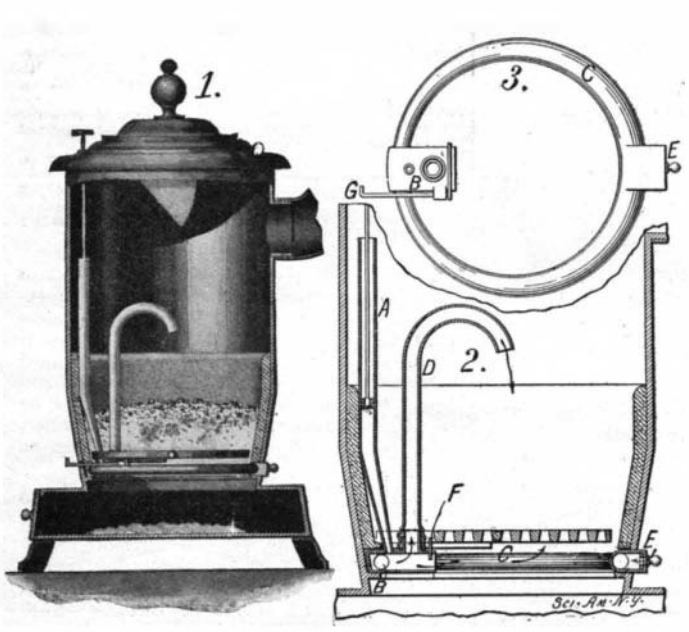
In the accompanying illustration we show what might be termed a "water cycle" invented by Dr. L. K. Baker, of Cleveland, O. The device is a foot-power machine for use in swimming, and so arranged as to secure greater speed from the kick or leg force employed. The power which is applied as in a bicycle operates to drive a propeller. The mechanism is attached to a bronze frame. Metal floats secured to the frame float the mechanism and the forward part of the frame is made hollow to support the chest of the operator. Materials which do not rust—bronze, copper, rubber, and aluminium—are used in the construction, and the completed machine weighs from twenty-three to twenty-six pounds. The average machine gives the user a yard of forward movement for each kick, when the arms are not used, and enables the average swimmer to double his speed. Children ten years of age soon lose their fear and pedal about in any depth of water even when there is a considerable sea. They consider it great sport to toss on the waves without danger of going down. Whenever desired the operator can lie on the machine without effort and rest, and at any moment can readily detach himself from the contrivance.



A NOVEL SWIMMING APPARATUS.

ATTACHMENT FOR STOVES.

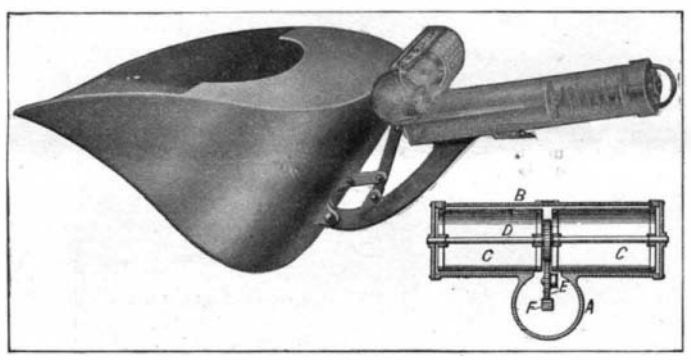
The accompanying engraving illustrates a novel attachment for stoves of the "air-tight" type, whereby hot air with more or less of a strong draft may be delivered simultaneously beneath and above the grate, or above the grate only when a slow fire is needed. The attachment also comprises an air pump, which may be operated to provide a strong forced draft when it is desired to quickly start up a slow or dying fire. The pump is situated inside of the stove, as best shown in Fig. 2, and the handle of the pump projects through the cover of the stove, so that it may be readily operated at any time. The pump piston is formed of asbestos, so that it will not be affected by the intense heat within the stove. The pump cylinder opens into a chest *B*, which is included in the circular trunk *C*. The trunk *C* is also formed with a draft box *E*, which opens through the side of the stove. This draft box is provided with the usual damper to control the amount of draft fed to the fire. Communicating with the chest *B* is a standpipe *D*, which passes upward through the grate and is bent over to a central position over the grate. The chest *B* opens into the stove under the grate, and this opening may be closed by means of the damper *F*, which is operated by the rod *G*, as shown in Fig. 3. In operation then, when the damper of the draft box is open, the air will pass through the circular trunk *C* and through the chest *B* to the lower side of the grate. Also some of the air will be drawn up through the standpipe *D* to consume the gases above the fire. If it be desired to keep the fire low the damper *F* is closed, when air will be supplied to the fire only from above through the standpipe *D*. When it is desired to produce a forced draft the pump *A* is operated, and forces air through the chest *B* and the standpipe *D* to the fire above and below the grate. The inventor of this novel attachment is Mr. E. P. Watson, of Bentonville, Ark.



ATTACHMENT FOR STOVES.

WEIGHING SCOOP.

Pictured in the accompanying engraving is a scoop provided with a weighing mechanism which will indicate the weight and the price per pound of the contents of the scoop. The scoop proper is hinged at its lower end to an arm formed on the handle *A*. This handle, adjacent to the scoop, is provided with a transverse cylinder *B*. Within the cylinder is a drum *C*, formed in two sections. The drum sections are mounted on a shaft *D* which at its center carries a gear adapted to engage a pinion *E*. The latter passes between the drum sections and meshes with a rack *F* which at its inner end is attached to a spring secured in the handle. The opposite end of the rack passes through the handle and is attached to a lever which is connected by a link with the scoop. It will be evident that if any article is placed in the scoop the latter will tend to swing downward on its fulcrum, drawing the rack *F* outward against the tension of the spring. The extent to which this rack is moved will indicate the weight of the contents of the scoop.

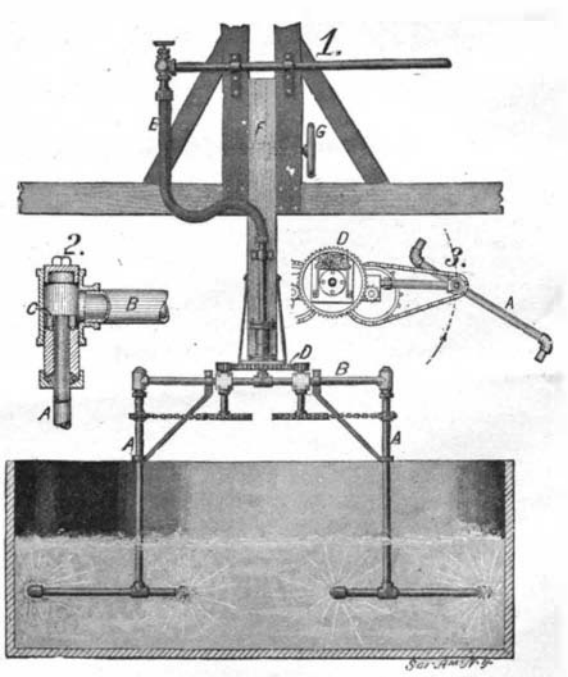


WEIGHING SCOOP.

The cylinder *B* is formed with a glass covered slot longitudinally disposed therein through which it will be possible to read various figures tabulated on the drum sections *C*. The entire surface of the drum sections is covered with figures arranged in circumferentially disposed rows. When the drum is standing at the zero position each of these rows will show a certain price per pound through the glass. Numbers representing multiples of this price, that is, the cost of two pounds, three pounds, etc., are arranged circumferentially of the drum so that if the price per pound were 15 cents, and there were two pounds in the pan, the rack *F* would be extended sufficiently to rotate the drum until the number 30 would appear under the glass. If it be desired to use the scoop without the weighing attachment the rack bar is moved back to its normal position, or until a disk on its inner end engages a spring latch. A thumb lever pivoted on the under side of the handle serves to release this latch whenever it may be desired. Means are also provided for adjusting the spring to the proper tension. The inventor of this weighing scoop is Mr. Frank C. Howe, of Globe, Arizona.

APPARATUS FOR AGITATING LIQUIDS.

The accompanying engraving illustrates a mechanism for stirring, agitating and oxygenating liquids, which, though it may be used with processes of various kinds, is particularly useful in the cyanid process of metal extraction. The machine is operated by compressed air to stir and agitate minerals which have been reduced to a fine powder and placed in a tank containing sodium or potassium cyanid solution, so as to dissolve their values, renovate the contact surfaces, and oxygenate the solution in order to increase its solving power. Figure 1 shows the apparatus in operation. Depending into the tank containing the cyanid solution are a pair of pipes *A* formed at their lower ends with tubular heads, each head ending in a pair of nozzles as shown in the plan view of Figure 3. The pipes *A* communicate with a transverse pipe *B* at their upper ends, the form of coupling being shown in Figure 2. The pipe *A*, it will be observed, projects through a stuffing box and is formed with a collar *C* at its upper end which has ball bearing with the top of the stuffing box. Thus, the pipes *A* are permitted to rotate. Each pipe *A* is connected by chain and sprocket gearing with a pinion journaled on the pipe *B* and which meshes with a fixed gear *D*. The pipe *B* communicates with a flexible pipe *E* which is connected to the compressed air supply pipe. In operation the air which is forced through the system of piping and out of the nozzles strikes the liquid in the tank, and by reaction causes the pipes *A* to rotate. This motion is communicated to the pinions which, by reason of their engagement with the fixed gear *D*, cause the pipe *B* to rotate and revolve the pipes *A*. The pipe *B* and the fixed gear *D* are secured to a beam *F* which is arranged to slide in the main frame of the apparatus. A pinion operated by the hand-wheel *G* engages a rack on this beam and provides for vertical adjustment of the apparatus so as to move the pipes *A* to any desired depth in the tank. We are informed that several of these machines are now in operation in Mexico and have shown very good results. The inventor of this improved agitator is Mr. Benito Solis, of Guadalupe de los Reyes, Sinaloa, Mexico.



APPARATUS FOR AGITATING LIQUIDS.

A recent French patent granted to the Compagnie Française des Produits Fixateur has for its object a stopper of stamped metal, of wood or other material, having a conical form and containing at the lower part a groove which contains a circular rubber band or similar elastic piece. This stopper is used in the following manner. After placing the rubber band in position, the stopper is inserted in the neck of the bottle, the latter having been filled with the liquid to be preserved. The neck of the bottle must be conical, so that the stopper fits into it snugly and its top does not rise above the neck of the bottle. The bottle thus provided with its stopper is placed in the corking machine, which is provided with a special device allowing a vacuum to be made as completely as possible above the stopper. The air contained in the bottle is drawn off, and the stopper rises to let it pass. When the operator judges the vacuum to be sufficient, he operates the machine to press the stopper into place again and also allows the air to enter above it. The bottle is thus hermetically sealed, the rubber band preventing the outer air from entering. Bottles thus stopped can be opened with a pointed instrument or even with an ordinary corkscrew.

A substance known as phycophaein has generally been considered as the material to which the color of the brown seaweeds is due. Tswett, however, has recently stated (in Ber. Deutsch. Bot. Gesellsch.) that this substance does not exist in the living seaweed, and is not present in the chromatophore, but is a post-mortem product. A mixture of the following substances, present in the chromatophore of the living plant, gives the brown color to the alga: carotin, chlorophylin, fucoxanthin, and fucoxanthophyl.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

BURGLAR-ALARM RELAY-DROP. — D. D. FRIEDMAN, New York, N. Y. This invention relates to certain improvements in relay drops especially useful in burglar alarm systems and relates more particularly to a new and improved means whereby the armature of an electro-magnet may be locked in position upon the breaking or closing of the circuit.

TROLLEY-POLE CATCHER.—J. H. WALKER, Lexington, Ky. In this case the invention is an improvement in trolley pole catchers, and particularly in that class of such devices illustrated by Mr. Walker's former patent, and the present invention relates to certain improvements in the track rail and in the carrier operating thereon. In operation, many advantages are secured in manipulating the trolley pole.

Of Interest to Farmers.

COTTON-CULTIVATOR.—R. H. PURNELL, Rosedale, Miss. This cotton cultivator is of simple and inexpensive construction and the cultivator devices proper are adapted for reversal on a beam so that the implement may be used for scraping the sides of a cotton row or for ridging the same by throwing dirt toward the plants, as conditions may require.

POULTRY-FOUNTAIN.—C. F. GILI, La Harpe, Ill. The purpose in this improvement is to provide a drinking fountain for poultry comprising a tank, a tray and means for holding the tank fast to the tray, yet admitting of a ready separation of said parts, the attaching means also serving as a handle whereby to facilitate the ready removal of the device from place to place.

Of General Interest.

TUBULAR WELL-PLUNGER.—E. R. LOCKWOOD, Pratt, Kan. The invention refers particularly to improvements in a device for holding the plunger valve open to permit water to pass through the plunger when it is withdrawn from the well tube, the object being to provide a device for this purpose that will be simple in construction and that will positively hold the valve open.

PUNCH.—S. BOISSEAU, Richmond, Va. The object of the inventor is to provide a construction whereby to simplify the work of those using punches, especially railway ticket agents, by combining in one instrument a series of punches so that the ticket agent may make the several punches in a ticket without putting one punch down and taking another up, and also provide guides to aid lining up the tickets so they may be punched severally at the correct points.

ANIMAL-POKE.—A. WILLIMAN, Washington, Mass. The design of the improvements in this poke or collar is to prevent an animal from passing its head through a wire fence or the like with the intent of passing bodily through the fence. Under ordinary conditions it will not injure the animal, but will slightly penetrate the animal's shoulders should it attempt to break through a fence.

GOODS-HANDLER.—E. E. WELCH, Springdale, Ark. In this instance the invention pertains to goods handlers for lifting boxes from shelves located above hand-reach, and has for its object a peculiar, novel and improved device of the character stated, which in addition to its general novelty, shall be inexpensive to manufacture.

CONVEYER SYSTEM.—J. H. SHAY, Wallace, La. The various objects of the inventor are attained by providing the double block with a peculiarly arranged idler sheave which is located between the two sheaves of the block and separates the skidding and outhaul lines. He also provides a swivel connection between the two lines and interposes swivels into sections of the lines in certain positions so as to prevent disadvantage from the twisting or turning of the lines.

REINFORCED CONCRETE ARCH.—H. M. RUSSELL, JR., Wheeling, W. Va. The object in this case is to provide a concrete arch reinforced by steel or other material, and arranged to reduce the thickness of the arch to a minimum and still contain wholly within the concrete body the straight reinforcing metallic members, located in such a manner as to take up tensile stresses in the most efficient manner.

SEA-ANCHOR.—F. ROUSE, Honolulu, Hawaii. The invention refers primarily to a sea anchor or drag, fitted with a peculiarly arranged oil reservoir by means of which not only may the vessel's head be kept to the wind while lying to, but oil distributed to windward of the vessel, thus breaking the seas and enabling the vessel to ride out a gale with comparative ease.

AERIAL VESSEL.—T. ORGREN, San Diego, Cal. The purpose in this invention is to provide an aerial vessel of light construction, in which folding aeroplanes are employed in conjunction with a gas-containing cylinder, and further to provide a gas reservoir having valved connection with the cylinder, which reservoir when the valve is open automatically maintains a uniform and constant pressure of gas in the cylinder.

PAPER-FILE.—C. F. MCBEE, Athens, Ohio. In the present patent the invention is an improvement in interchangeable and permanent files for holding papers, and is especially designed for filing railroad tariffs and expense bill receipts, but which may be used for any other desired purpose. Its index sheets may be employed to great advantage in filing the above-named tariffs and receipts.

NON-REFILLABLE BOTTLE.—H. O. MCCLURG, Baltimore, Md. The bottle has a new form of valve closure or stopper which permits the overflow of the liquid contents, but effectually prevents inflow of liquids. The stopper is so constructed and secured in the bottle neck that it cannot be removed therefrom, while the valves are so protected that it is impossible to reach them with an inserted tool or instrument.

ERASER FOR TYPE-WRITERS.—E. C. MCFADDEN, Short Hills, N. J. This eraser is designed to render writing invisible as produced by the machine, without the need of rubbing it from the paper, as is the usual practice, but effecting the erasing by reproducing coincident therewith the characters desired to be erased and in an ink of the same color as the background of the paper or other material on which the characters appear.

ORE-MILL.—J. JOHNSON, Mesa, Ariz. Ter. This mill is intended and adapted for crushing, grinding, and thus pulverizing ore and other substances, and belongs to the class distinguished by a toothed, or armed, cylinder or shaft, rotating in fixed bearings, and a greatly enlarged drum, or cylinder, inclosing such cylinder or shaft, and revolving around it by the impact or friction of the two.

DISPLAY-SHELVING.—R. T. JOYCE, Mount Airy, N. C. The invention pertains to improvements in shelving used more especially in hardware stores wherein the shelving is arranged in the form of compartments to hold the various articles of hardware, and has for its object to provide an attachment for displaying samples of the articles contained in each compartment and also for indicating the condition, or rather quantity of stock on hand.

LABEL-PASTER.—G. N. BYL and J. KOEHLER, Jersey City, N. J. The purpose of the improvement is to provide an economic device for applying labels in quantities to an adhesive surface and so distribute the labels on the surface that while the labels lie close to each other, one will be independent of the other, and to accomplish the work systematically and with dispatch.

MARKER.—C. BECKMANN, New York, N. Y. This invention has reference to a marker or marking device adapted to be used by tailors or artisans for marking or laying out work. The object of the improvement is to produce a device which is simple in construction and which may be operated readily to produce a clear and well defined mark.

WEIGHING-SCOOP.—F. C. HOWE, El Paso, Texas. This scoop is for use in stores or similar places in selling products such as flour, sugar, etc. The weighing mechanism in connection with the scoop accurately indicates the weight. The handle is provided with a light which may be lit at will, so as to enable one using the scoop to illuminate the surroundings, in dark closets or under similar conditions.

Hardware.

PERMUTATION-PADLOCK.—M. J. O'LEARY, Chickasha, Ind. Ter. The invention relates to improvements in permutation padlocks and has for its object to produce a padlock of the type set forth, which shall be simple, efficient, and one which can be readily operated and the combinations (of which a great number may be used) changed at will in a simple manner without dismembering the component parts.

STAY-BOLT CUTTER.—E. T. STRONG, Urbana, Ill. The improvement refers to boiler-maker's implements, and its object is to provide a cutter arranged to permit of conveniently and quickly cutting the stay bolt inside of the sheet, to facilitate removal of a worn-out fire-box of a locomotive or other boiler, and without first requiring the removal of the back sheet of the boiler.

CLAMP FOR BASIN-COCKS.—T. L. CECIL, Coldwater, Mich. The invention is an improvement in clamps for basin cocks or faucets and has for an object, among others, to provide an efficient and simple locking means to positively prevent the cock from becoming detached from the basin, yet to allow the ready removal of the cock, without difficulty.

Heating and Lighting.

AUTOMATIC SAFETY-BURNER.—N. WISE, New York, N. Y. The object of the inventor is to produce a gas burner adapted to be used for illuminating or heating purposes, and which is constructed in such a way that, if the flame becomes extinguished by accident without the gas having been turned off, the burner will automatically shut off the flow of gas.

Household Utilities.

PAN-SUPPORT.—R. P. COOK, Hastings, Mich. Generally stated, the invention consists of clamping jaws with suitable operating handles adapted to be applied to the pan handle and adjusted thereon, to bring a base plate carried by them in the same plane with the bottom of the pan, thereby forming a support from the handle slightly spaced from the pan, making it impossible to accidentally turn the pan over.

BED-BOTTOM.—G. BEZANGER, Boston, Mass. The object of this invention is to provide a device which may be applied to beds or couches of the common type without change or alteration in the same, and which affords means for raising or elevating the mattress at different points and in different degrees. It is especially useful in connection with beds and the like, intended for use of invalids or those having physical disabilities.

Machines and Mechanical Devices.

CHANGEABLE DRIVE-GEAR.—J. WIECHMANN, Albany, N. Y. The invention relates to the transmission of power, and its object is to provide a drive gear, arranged to insure an easy yet powerful transmission of power from one shaft to another, and to allow convenient and quick change of speed and reversal of the motion without danger and shock to the connected parts.

DITCHING-MACHINE.—W. UMSTEAD, Jerseytown, Pa. The purpose in this case is to improve upon the ditching machine for which Letters Patent were formerly granted to Mr. Umstead, whereby the point of the plow is given downward curve at its working end, rendering it more effective in service, and ground entrance more gradual, and further making the point detachable and providing a long flat surface for the working face of the plow at the point, and imparting a twist to the plow where the point joins the mold-board section in order to start the ground to the section to be moved along by the cleaning wing at the surface of the ditch.

TYPE-WRITING MACHINE.—R. REIN, Sebastianstrasse 14, Berlin, Germany. In accordance with this invention several defects are obviated. To this end the device for releasing the locking pawl is positively connected with the operating lever in a certain manner. The arrangement is such that the disengagement of the pawl is effected by means of a special manipulation of the lever carrying the operating pawl, for example in such a manner that this lever is displaced from its position of repose in the direction opposite to that in which it is moved for line spacing. By this arrangement many advantages of great importance in the use of the machine are obtained.

CARPET-BEATER.—O. O'HALLORAN, New York, N. Y. This portable beater is especially adapted to be operated by hand. One of the purposes of the inventor is to so construct the device that in operation beater arms of opposing series will be automatically and intermittently raised and permitted to drop under spring control, thus whipping a carpet in the same manner as practised by hand.

SOAP CUTTING AND PRESSING MACHINE.—H. W. MCEWEN, Chicago, Ill. The invention comprises an improved machine for cutting long bars of soap into short sections and pressing each of said sections into a regular sized cake. The object is to produce a device which is automatic in its operation and which carries on all the necessary steps in their regular sequence without the aid of or attention of a skilled operator.

Prime Movers and Their Accessories.

VALVE-GEAR.—H. LENTZ, 123 Kurfiirstendamm, Halensee, near Berlin, Germany. The object of the inventor is to provide means for obtaining an additional opening of the exhaust valve during the period of compression when starting the motor. The means for diminishing the counter-pressure consist in a movable boss arranged in the reciprocating distributer containing the valve, which boss rocks with the distributer, being pressed toward the interior of the distributer by the spring and caused to project by the displacement of an axial wedge or an equivalent part, in order to act upon the exhaust member.

ROTARY ENGINE.—F. R. BUSSARD, Hays, Kan. In the present patent the invention has reference to improvements in rotary engines, the object being the provision of a rotary engine of simple construction, and that may be operated by an economical amount of steam used expansively, or by direct pressure from the boiler.

Railways and Their Accessories.

SWITCH.—W. J. MCKEWEN, Philadelphia, Pa. In carrying out the present invention which has reference to switches designed to be used in connection with motor cars, the inventor has for his object in view the provision of means adapted to hold a switch point locked firmly in position when adjusted.

Pertaining to Recreation.

AMUSEMENT DEVICE.—W. T. WATSON, Vancouver, British Columbia, Canada. The object of the invention is to provide means whereby the car-carrying wheel moves around in a circle with the supporting platform, but whereby the wheel is caused to continuously rotate in opposite direction. This produces an unusual motion. The invention relates to improvements over the device disclosed and claimed in a former application by Mr. Watson. This inventor has secured a patent on another amusement device, its object being to increase the movement imparted to the cars making the movements diverse and confusing, thus increasing the interest of passengers. This end he attains by causing the wheel or wheels not only to revolve on their own axes, but to move bodily in a circle or other fixed path.

FIGURE TOY.—A. R. REIHING, Toledo, O. The invention is an improvement particularly in toy fowls or birds, and the object is to provide a construction in connection with a toy representation of a hen and a spring for causing the same to rise from its nest, of means for restraining the action of the spring, and egg delivery devices operated from said restraining means.

Pertaining to Vehicles.

SPRING-WHEEL.—W. O. TUBBS, Lubbock, Texas. The invention pertains to improvements in wheels for vehicles, its object being to reduce jar and produce a wheel which shall be cheap and efficient. Pneumatic tires generally used on vehicles, such as automobiles, are costly and extremely liable to puncture and other damage, to repair which involves considerable time and expense. The improvements of Mr. Tubbs overcome the above objections.

MANUFACTURE AND APPLICATION OF RUBBER TIRES TO WHEEL-RIMS.—I. W. GILES, New Bedford, and C. W. TOBEY, Fairhaven, Mass. In this case the invention has reference to the manufacture and application of rubber tires to wheel-rims, the object of the improvement being to provide a method whereby rubber tires may be quickly and securely attached to wheel-rims without the use of the tools commonly used for that purpose.

RUBBER-TIRE FASTENER.—I. W. GILES, New Bedford, and C. W. TOBEY, Fairhaven, Mass. These patentees employ circular rods embracing the rubber tire at the metallic tire. At intervals the rods pass through eyes formed on the ends of a turn buckle device extending crosswise of the tire and which may be adjusted by a wrench to tighten or loosen the clamp rods.

EXTENSIBLE WAGON.—E. RIEDINGER, New York, N. Y. In the patent of Mr. Riedinger the invention has reference to wagons, and the object of the improvement is the provision of a construction for the body which will enable the same to be extended when desired and locked to the extended position.

BICYCLE.—H. GARZA, Monterey, Nuevo Leon, Mexico. An auxiliary propelling mechanism is actuated by the swinging of the outer section of the handle-bar, it being evident that when the section is swung forwardly the gear wheel will be rotated and when the section is swung rearwardly the pawl will slip idly over the ratchet teeth. Rotation of horizontal gear wheel is imparted through a gear wheel to the sprocket wheel and by a chain and other sprocket wheel to the rear wheel.

LINING FOR PNEUMATIC TIRES AND OTHER PNEUMATIC ARTICLES.—F. PETMECKY, Austin, Texas. In the present patent the object of the invention is the provision of a new and improved lining for pneumatic tires and other pneumatic rubber articles, and arranged to immediately, efficiently, permanently and quickly heal or close a rupture in the article.

WAGON-GEAR.—W. A. MURRAY, Sanford, Fla. The object of the invention is to provide a wagon gear combining maximum strength and lightness and durability with adaptability for economy in manufacture. Draft and other strains are applied to the axle at various points throughout its length, so that a smaller and lighter axle may be employed than is usual in this class of wagon gear.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10524) C. F. G. asks: Will you kindly give in your Notes and Queries column a process for preserving botanical specimens unchanged in color and form? A. There is no liquid which will preserve all botanical specimens unchanged in color and form. Fungi cannot be preserved without loss of color by any means, whatever. A weak solution of formalin, say one or two per cent, will act as well as any.

(10525) J. B. writes: Referring to the solution of a problem in SCIENTIFIC AMERICAN, March 16, 1907, page 239, number of answer 10439, P. A. O., I would say that I cannot understand why you make such an elaborate statement to show the best mathemati-

cians in that particular town how to solve such a simple problem in proportion. Furthermore, the chances are that the best mathematicians in that town do not comprehend your statement and solution. The solution is as follows (three known and one unknown quantity): Woman is to man as man is to woman and pig.

Therefore $139 : 160 :: 160 : 139 + x$.

For convenience call $139 + x$ simply x.

$$\text{Then } x = \frac{160 \times 160}{139} = 184\frac{24}{139}.$$

$$184\frac{24}{139} - 139 = 45\frac{24}{139} \text{ pounds.}$$

45 pounds and nearly 3 ounces weight of pig. A. We have received many letters concerning the man and woman who weighed the pig without scales, by balancing on a pole laid across a rail. Most of them are critical, and charge that we give too long a solution. The solution above is a sample of these claimed to be better than ours. If that is the sort of thing any one wants, as Mr. Lincoln said, it is just the sort of thing any one would want. We submit that it does not explain itself at all. If any one could solve the problem, he would not require it; and if he could not solve the problem, this solution would be of no assistance to him in his effort to do so. It gives no reason whatever for any step taken. Every solution for the use of one who is to be instructed by it, ought to make clear each step, and lead the learner along from step to step clearly. The problem is one of a lever with unequal arms balanced about a fulcrum. Our solution recognizes that fact, and not one of those sent in by our critics makes any mention of the principle upon which their solutions are based.

(10526) J. M. B. writes: In Notes and Queries 10439, in your issue of March 16, you published a problem and answer relating to the properties of the lever or arm and fulcrum. I think that you have kindly and obliging feelings toward your readers when you take notice of such, as it does not seem to me to be in your line. I discovered a rule bearing on the matter while investigating the same properties. I have never seen it published, and think that it is a new one, although I may be mistaken; however, it is a simple one, and may be useful to some of our friends who are not posted in algebraic formula. I inclose it herewith, as you may think it available for publication. Proposition: If an arm is balanced on a fulcrum by unequal bodies on each end, the weight of each being known, if on reversing the position of the bodies it is required to be known how much to add in weight to the lesser body to preserve the balance. Observe the following rule: Let the value of the arm be put = 1. This value of the arm in this rule is arbitrary and is the exception; let x = the weight required. Then it will be: As the sum of the weights is to the difference of the weights, so is 1 to the difference of segments of 1; and by rule ½ ± ½ of the quotient will give the segments. Then the difference of the weights ÷ the lesser segment will = x, the weight required. This rule is constant and invariable, and the proof of the work is found by the fundamental rule that the product of the weight and segments of each side are equal to each other.

(10527) E. A. P. says: I have a "Brownie" camera No. 2, and have taken eighteen snapshots (three films). When I came to develop them, the pictures were all black, so that I could not see anything. Can you tell me what it was that made them so black? I am sure that I developed them right. First: I put the pictures in the water. Second: In the hypo-soda. Third: In the developing powders. Fourth: In water to rinse. A. You began at the wrong end. If an exposed film is placed in hypo first, then in the developing solution, it will blacken over. The rule is to moisten the film first with water, then place it in the developing solution, then rinse with water, and lastly put it in the hypo-soda fixing bath until the creamy white portions are entirely dissolved out. Then it is washed in water for half an hour and hung up to dry.

(10528) B. & Co. say: Will you kindly give us the horse-power that a heavy-duty horizontal Atlas engine will develop with inside diameter of cylinder 12 x 18 inches, running 175 revolutions per minute with 100 pounds steam pressure? A. The horse-power which a steam engine will develop depends entirely upon the point of cutoff, when the size, boiler pressure, and speed are given, or in other words, upon the fraction of the stroke during which steam is being admitted to the cylinder. It is possible to have the cutoff so early that the average pressure in the cylinder during the stroke will be approximately equal to zero. With the cutoff at about one-third the stroke, the boiler pressure 100 pounds, and the revolutions equal to 175 per minute, the horse-power of your engine would be approximately 85.

(10529) L. L. L. says: If a pipe 2 inches in diameter, connected to a larger pipe carrying a pressure of 100 pounds to the square inch, had a nozzle put on it with a 1-inch hole in it, would it discharge as much water as the pipe would before the nozzle was put on? If the water would not have a greater pressure at the nozzle, but have an increased velocity? Where does the lost pressure go to if it is not in the velocity? How can we increase the velocity of anything without increasing the pressure? A. We would say that there would be a smaller quantity of water discharged through the 1-inch nozzle than would be discharged through the 2-inch open pipe, but the velocity would be greatly increased, and the pressure in the 2-inch pipe would also be increased by this use of the nozzle. It is impossible to increase the velocity of a liquid flowing from a nozzle without increasing the pressure at the same time.

(10530) W. P. D. says: I am informed by an experienced miller that in the running of his turbine wheels he always has to turn off part of the water at dark to maintain a uniform rate of speed of his millstones. Is this a scientific fact noted and established in the working of water-power wheels? If so, why? A. We would say that we do not know why the miller has to turn off part of his water supply at the time you mention, but it is probably for some other reason than because of darkness. It does not make any difference whether it is daylight or dark, the same energy has to be expended to do the same amount of work. 2. Also I have frequently noticed (as well as being asked by others who have noticed it) that in riding a bicycle during twilight or after dark the machine appears to require less power than during daylight. Is this real or imaginary? If real, why? A. The reason that it seems easier to ride a bicycle after dark, especially upon a road which is familiar to the rider, is that the rider cannot see the road over which he is riding, or the stationary objects along the road, as plainly as he does in the daylight, and consequently does not seem to realize that he has exerted or is exerting as much energy as he would be exerting if it were daylight, in riding over the same road. He seems to be moving faster than he really does, and thus feels that little exertion is required. 3. In your issue of March 16 you work a problem regarding the weight of a pig by algebra. To the majority of your readers, who like myself do not work algebra, your solution is lost. Here, however, is a solution to it in ordinary arithmetic, by a rule we used to call "position" or "supposition": First suppose the plank to be say 12 feet long. This multiplied by the weight of the man, 160 pounds, and divided by the combined weights 160 + 139 = 299 pounds, would give 6.4214 feet, which subtracted from the 12 feet, would give 5.5786. These two numbers give the relative lengths of beam from the point of balance. Now as the man (160 pounds) is to be on the long end of the plank next time, 160 × 6.4214 ÷ 5.5786 will give the weight required on the short end. This is 184.17 pounds; that is, the woman and pig, 184.17 — 139 leaves 45.17 pounds, the weight of the pig. A. We would say that your method of solving the problem described is correct. There are several ways of arriving at the correct result of the problem, we believe; and the method used, either the algebraic or "supposition," is dependent upon the principle of solving an equation for unknown quantities, whether these quantities are represented by letters or "supposed" figures.

(10531) D. L. M. says: Will you kindly answer through your Notes and Queries the compound used for brazing cast iron? A. We would say that the flux used in brazing cast iron is powdered borax. The spelter used is prepared especially for brazing cast iron, and is generally in a granular form, the grains averaging perhaps the size of coarse sugar. The composition of this spelter depends upon the nature of the iron to be brazed, or rather the heat which the iron will stand, as the spelter must melt and flow readily at a temperature below that of the melting point of the iron. The brazing metal is made of copper and zinc in the proper proportions.

(10532) B. W. H. asks how to make tracing paper. A. A German invention has for its object the rendering more or less transparent of paper used for writing or drawing, either with ink, pencil or crayon, and also to give the paper such a surface that such writing or drawing may be completely removed by washing, without in any way injuring the paper. The object of making the paper translucent is that when used in schools the scholars can trace the copy, and thus become proficient in the formation of letters without the explanations usually necessary, and it may also be used in any place where tracings may be required, as by laying the paper over the object to be copied it can be plainly seen. Writing paper is used by preference, its preparation consisting in first saturating it with benzine, and then immediately coating the paper with a suitable rapidly drying varnish before the benzine can evaporate. The application of varnish is by preference made by plunging the paper into a bath of it, but it may be applied with a brush or sponge. The varnish is prepared of the following ingredients: Boiled bleached linseed oil, 20 pounds; lead shavings, 1 pound; zinc oxide, 5 pounds; Venetian turpentine, ½ pound. Mix, and boil eight hours. After cooling, strain, and add 5 pounds white copal and ½ pound sandarac.

(10533) S. J. M. asks how to detect sulphuric acid in vinegar. A. We have received so many letters on this subject that we are compelled to decline publishing many good methods which our correspondents have forwarded. The following, however, will give housekeepers, and others to whom chemical processes are not accessible, an opportunity of testing the purity of the article. The following is Fresenius' test, simplified for general purposes: Put a wine glassful of the vinegar into a china tea cup, and let the cup float in water in a pint cup of tin or other metal that will stand heat. Boil the water till half the vinegar has evaporated, then drop into the cup a piece of (cane) loaf sugar about the size of a grain of wheat. Continue the boiling till the liquid in the cup has evaporated, when, if the vinegar contains free sulphuric acid, the dry residue will be found to be blackened. The charring of the sugar is due to free sulphuric acid.

(10534) A. P. W. asks how to deodorize petroleum. A. Mix chloride of lime with petroleum in the proportion of three ounces for each gallon of the liquid to be purified. It is then introduced into a cask. Some muriatic acid is added and the mixture is well agitated, so as to bring the whole of the liquid into intimate contact with the chlorine gas. Finally the petroleum is passed into another vessel containing slaked lime, which absorbs the free chlorine and leaves the oil sufficiently deodorized and purified.

NEW BOOKS, ETC.

Electricity as Applied to Mining. By Arnold Lupton, G. D. Aspinall Parr, and Herbert Perkin. Second edition, thoroughly revised and enlarged. London: Crosby Lockwood & Son. New York: D. Van Nostrand Company. About 190 illustrations; 8vo.; cloth; 320 pages. Price, $4.50.

Such wide use is made of electricity in mining, that there is need for a textbook on the subject. The volume of which we are now writing should meet the need very well. It contains descriptions of dynamos, ways of transmitting current, transformers, motors, and their application to the operation of mining machinery, systems of lighting, and the use of electricity in exploding blasts.

The Theta-Phi Diagram. Practically applied to Steam, Gas, Oil, and Air Engines. By Henry A. Golding. Second edition, revised and enlarged. Manchester, England: The Technical Publishing Company. 16mo.; cloth; 126 pages. Price, $1.25.

This work is a presentation, in as simple and practical a manner as possible, of the use of the temperature-entropy diagram and the various methods of drawing it for different heat motors. This most important subject has been too rapidly slurred over in the past, owing to the mathematical difficulties surrounding its study. Now, since the publication of Mr. Golding's book, these difficulties have been largely removed, and the science put in a form where all may readily approach it.

The Common Bacterial Infections of the Digestive Tract and the Intoxications Arising from Them. By C. A. Herter. New York: The Macmillan Company. 12mo.; cloth; 360 pages. Price, $1.50 net.

This volume embodies views recently presented by the author to the New York Academy of Medicine, in a lecture before the Harvey Society for the Diffusion of Medical Knowledge. The object of their p blication in book form is to place before the notice of practitioners and investigators a number of important details, not suited for publication in a medical journal. The work is in no sense a popular treatise, but could be profitably read even by the layman, for there is no question of such vital importance as that of bacterial action in the digestive tract.

How to Build a Direct-Current One-Kilowatt Dynamo or a One Horse-Power Motor. By A. E. Watson. Lynn, Mass.: The Bubier Publishing Company. 16mo.; cloth; 100 pages; illustrated. Price, $1.

A complete set of directions for making and assembling the parts of a practical and up-to-date dynamo or motor. This book is not a "boy's handbook," but a technical work of merit and usefulness.

A Glossary of Terms Used in English Architecture. By Thomas D. Atkinson. New York: William T. Comstock. With 265 illustrations; 320 pages; 16mo.; cloth. Price, $1.50.

A very good glossary, limited to the historical aspect of architecture, yet devoting especial attention to that part of the subject which bears on social and religious life.

Race Culture; or, Race Suicide? (A plea for the unborn.) By Robert Reid Rentoul. London and New York: The Walter Scott Publishing Company. 8vo.; cloth; 182 pages. Price, $3.

The increased complexity of modern social conditions is forcing a very disagreeable question before our notice; namely, the question of race perpetuation with regard to race improvement. In America we are somewhat ahead of Great Britain, yet Dr. Rentoul's book has many suggestions that we might profitably apply to our conditions over here. His plan imposes less hardship upon the class it deals with than any other that has been put forth up to date, while, at the same time, it seems to offer the desired cure for the evils it is intended to do away with.

Fire Assaying. A Practical Treatise on the Fire Assaying of Gold, Silver, and Lead, Including Description of the Appliances Used. By Evans W. Buskett. New York: D. Van Nostrand Company. 16mo.; cloth; 105 pages; illustrated. Price, $1.25.

A very good short work on assaying, containing directions and descriptions of apparatus. It is especially to be recommended for those who have had the practical experience without the technical education.

Experimental Zoology. By Thomas Hunt Morgan. New York: The Macmillan Company, 1907. 12mo.; 448 pages; cloth; 25 illustrations. Price, $2.75 net.

A collection of the results that have been obtained in the field of experimental zoology during the last fifteen years. Many details that an exhaustive treatment would demand have been omitted, as only such cases have been selected as are the most typical and the most instructive. The chief stress of the work is laid upon the determination of the conditions under which changes in form occur. The book should appeal to all intelligent readers who are interested in this fascinating subject.

Boiler Waters, Scale, Corrosion, Foaming. By William Wallace Christie. New York: D. Van Nostrand Company. 8vo; cloth; 77 illustrations; 235 pages. Price, $3.

This work is intended to furnish steam users with information regarding water, its use, and the troubles arising from the presence of impurities in it, as well as with their proper remedies wherever possible. Analyses of various boiler waters are given, and the effects of the dissolved substances discussed in each case. Means of detecting the more common scale forming and injurious compounds are presented, enabling the engineer to make his own preliminary tests without calling in a chemist.

A German Science Reader. With Notes and Vocabulary. By William H. Wait, Ph.D. New York: The Macmillan Company. 12mo.; cloth; 321 pages. Price, $1 net.

It is the aim of this work to give to those who desire a knowledge of technical and scientific German a conveniently arranged collection of articles covering the principal sciences. The selections are so chosen that a specialist in one subject can profitably read the portions of the work devoted to the sciences which are related to the one he is chiefly interested in.

An Elementary Treatise on Theoretical Mechanics. By J. H. Jeans. New York: Ginn & Co. 8vo.; cloth; 364 pages, illustrated. Price, $2.50.

Although quite young, Prof. Jeans is regarded as the physicist of the greatest promise of the present day. In the realm of mechanics he is particularly at home, especially from the theoretical standpoint; so that the present book, intended to furnish a short course for beginners, is of double value. The subjects dealt with are the general principles of dynamics, the laws of motion, statics, dynamics of a particle and of rigid bodies. The treatment aims at elucidating physical principles rather than at elaborating a mathematical theory. Care has been taken to illustrate all principles and results by a series of practical examples and applications. The amount of mathematics in the text has been reduced to the minimum which is consistent with giving the student exact ideas and the knowledge necessary for performing exact calculations. A great many exercises and problems are inserted for solution by the student, and especial care has been taken to make these as representative and as illustrative as possible.

The Book of Vegetables and Garden Herbs. A Practical Handbook and Planting Table for the Vegetable Gardener. By Allen French. New York: The Macmillan Company. 12mo.; cloth; 312 pages, 144 illustrations. Price, $1.75 net.

An alphabetically-arranged list of vegetables suited to cultivation in the northern United States, with the best times for planting them, and the conditions and methods of cultivation most favorable to their growth. To all who own gardens this book will come as a great help, giving, as it does, not only practical advice in how to plant, but assistance in choosing what to plant in order to obtain the greatest yield.

Inorganic Chemistry for Schools and Colleges. By James Lewis Howe. Being a second edition of Inorganic Chemistry According to the Periodic Law, by F. P. Venable and J. L. Howe. Easton, Pa.: The Chemical Publishing Company, 1907. 12mo.; cloth, 409 pages, 70 illustrations. Price, $3.00.

An excellent general and descriptive book, dealing with the theory of the subject from the modern physico-chemical standpoint. The author preserves a very just balance between theoretical and practical considerations, making the work of the greatest service for all

but the merest beginners. A good text-book for higher schools and colleges.

QUESTIONS AND ANSWERS FROM THE GAS ENGINE. Cincinnati, Ohio: The Gas Engine Publishing Company. 12mo.; cloth; 278 pages. Price, $1.50.

A collection of questions and their answers compiled from the more interesting and valuable ones that have appeared in the "Answers to Engineers" column of the Gas Engine. Covering nearly every phase of this perplexing subject, they present in compact form information of great value.

ELECTRICAL ENGINEERING. An Elementary Textbook. Suitable for Persons Employed in the Mechanical and Electrical Engineering Trades, for Elementary Students of Electrical Engineering, and for All who wish to Acquire a Knowledge of the Chief Principles and Practice of the Subject. By F. Rosenberg. Translated by W. W. Haldane Gee and Carl Kinzbrunner. Authorized edition, revised and brought down to date for the American market by Edward B. Raymond. New York: John Wiley & Sons. 8vo.; cloth; 347 pages; 333 illustrations. Price, $2.

A simply-written elementary work for those who wish a clear textbook that is not crowded with mathematical formulæ. It covers a wide area, comprising, besides the fundamental phenomena of the electric current, dynamos and motors for continuous, alternating, and three-phase currents, accumulators and their apparatus, measuring instruments, and electric lighting. The work is especially noticeable for its full and lucid explanation of alternating currents.

STAR AND PLANET FINDER. By Leon Barritt and Garrett P. Serviss. New York: Leon Barritt, 1906.

The new star and planet finder is a decided improvement on the old planisphere—that indispensable adjunct of the amateur astronomer. To those who may be unfamiliar with the planisphere, we would explain that it is a star chart which may be revolved under a fixed cover to set positions for each hour of the day and each day of the year. An opening in the cover shows a map of that portion of the heavens that is visible on the day and hour for which the chart is set. Although excellent as far as it goes, the planisphere falls short in that it does not indicate the position of the planets, whose irregular apparent motions render them far more interesting to the layman than the "fixed" stars, which return to the same apparent position year after year with the regularity of clockwork. The improved planisphere of Messrs. Barritt and Serviss meets this need of the amateur by the provision of nine disks to represent the sun, moon, and planets. Each disk is formed with a central pin point, whereby it can be attached to the chart, like a thumb tack, wherever desired. The ecliptic, which is virtually the path of the planets, is shown by a red line on the chart and is marked off in degrees. A table which is furnished with the chart shows just where the disks should be applied on the ecliptic for successive dates covering a period of twenty years. Thus the progress of the planets may be studied, and the chart may be consulted at any time to show, within a few degrees, just where a certain planet is to be found. The chart itself is very clear, the constellations and principal stars are named, but to avoid confusion, no Greek letters are used. The stars are made large or small according to their magnitude, instead of indicating their brilliancy by means of the customary rays. Altogether, the new star and planet finder is a most valuable aid to the study of elementary astronomy.

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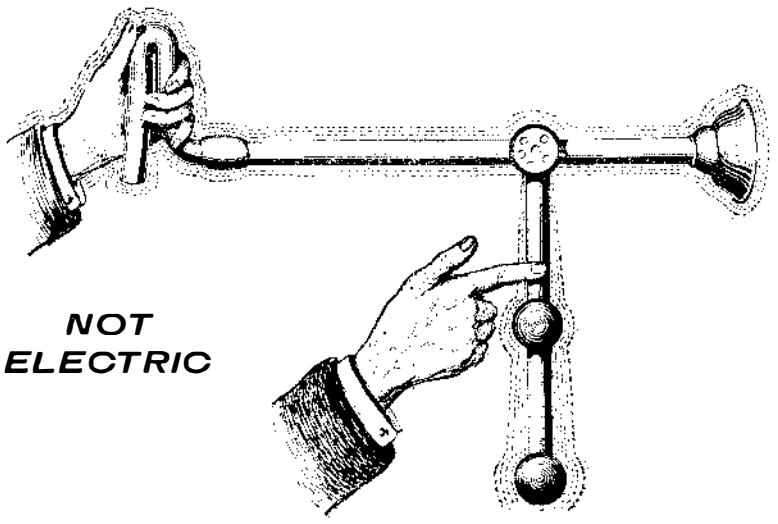

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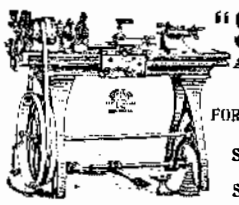

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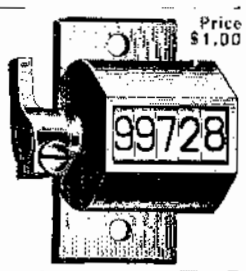

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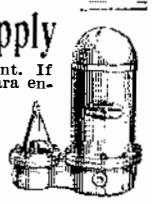

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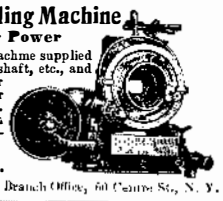

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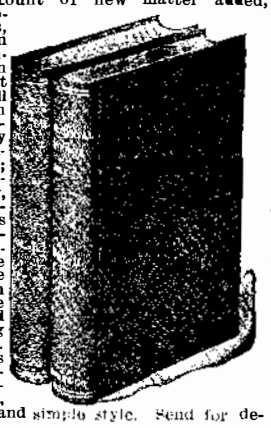

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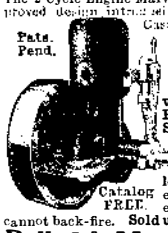

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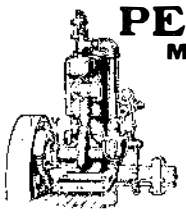

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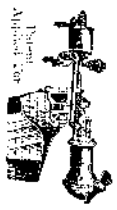

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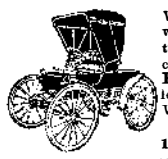

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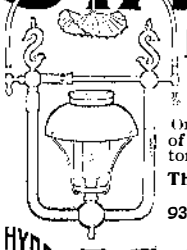
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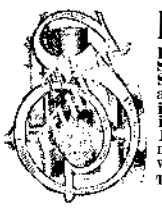
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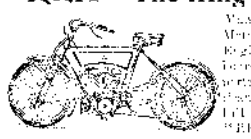
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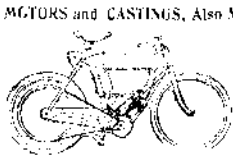
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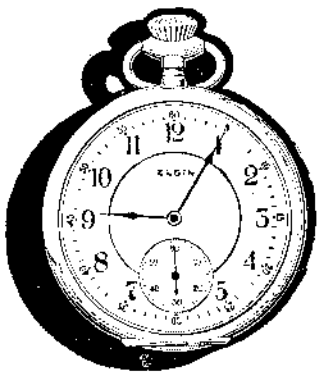

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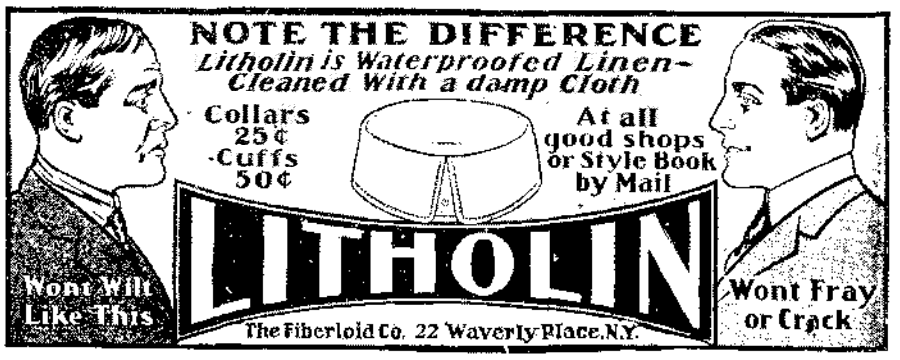
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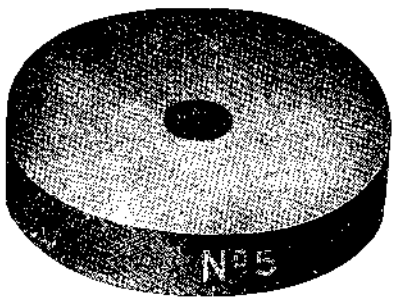

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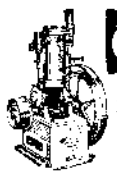

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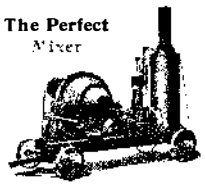

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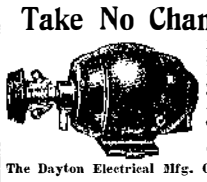

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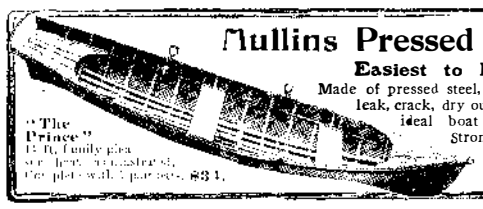

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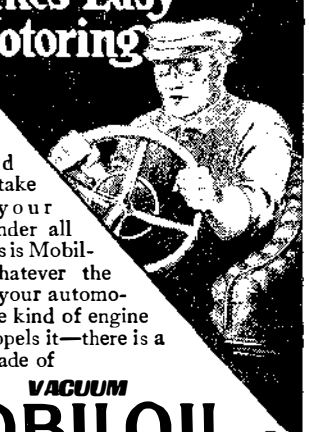

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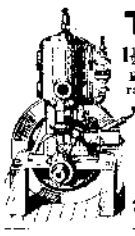

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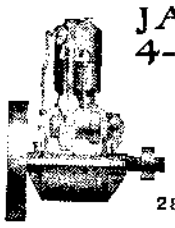

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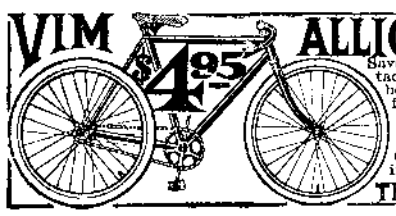

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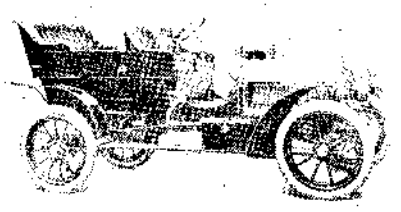

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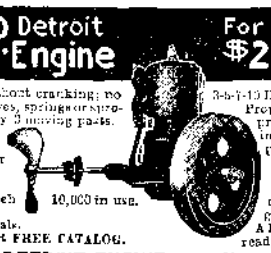

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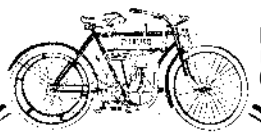

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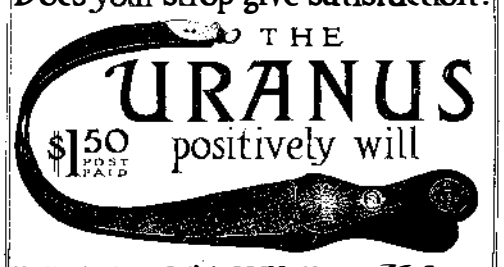

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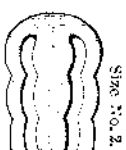

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